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KREOLITE
WOOD BLOCK FLOORS
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FROM the tree to the finished Factory Floor, Kreolite Wood Blocks undergo a process of seasoning, manufacture and treatment specifically designed to produce a block that will give absolute satisfaction regardless of the conditions to be met.
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Lackawanna Steel Sheet Piling is Invariably Preferable to Boiler Plate for Bridge Pier Foundation Cofferdams

When the Seaboard Air Line bridge across the Wateree River was destroyed by flood, a hurry call for Lackawanna Steel Sheet Piling was received from Hillyer & Sperring, Contractors, Jacksonville, Fla., who had the option of using Lackawanna Sheet Piling or a boiler plate cofferdam in repairing the pier foundations.

A 67-ton shipment of Lackawanna Arched-Web Section in 38-foot lengths was rushed to this job, assembled to a template, driven, excavated, and concrete placed as shown in the photographs.

The sheet piling was assembled complete and then driven to what seemed to be refusal, by a 5600-lb. Vulcan Hammer. Excavation showed 10 feet of hard clay with disintegrated granite underlying. After excavating to within 4 feet of bed rock, the sheet piles were driven an additional 3 feet and no further trouble was experienced.

Mr. C. E. Hillyer, president of the contracting firm, writes us:

"The excavation was the cleanest I have ever seen, and a 5-in. Emerson Pump running very slowly took care of the seepage. The total working time was 60 days. Our experience proved that we pursued the most satisfactory method."

Sinking or driving steel plate construction for pier cofferdams may be very difficult and slow, and leakage from underneath may be hard to prevent. A Lackawanna Sheet Piling structure overcomes these difficulties, as the piling sections may be assembled complete, but driven one at a time, each forming its own seal with bed rock, and the whole becoming thoroughly watertight.

In work of this kind it's better to use Lackawanna Steel Sheet Piling *first*, than come to it later.

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Lackawanna Steel Company

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Engineering News

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Southern Power Company Adds 40,000-Hp. Capacity to Its System

By starting up the 40,000-hp. Fishing Creek station of the Wateree Power Co., at the close of 1916, the Southern Power Co. placed in service the largest of its seven hydraulic stations and completed the 100,000-hp. development of the Great Falls district of the Catawba River near Charlotte, N. C. The site of the new station is just above the entrance of Fishing Creek into the Catawba, and at the head of the rapids locally known as the Great Falls. Below the new station are the Great Falls and Rocky Creek stations of the company, each of 32,000-hp. capacity.

FIG. 1. FISHING CREEK DAM AND STATION DURING CONSTRUCTION

View from downstream on June 1, 1916, showing the use of material tracks and tall steel derricks by the contractor, the Hardaway Contracting Co., of Columbus, Ga.

The accompanying map (Fig. 2) shows the great development of the Southern Power Co. system of transmission lines as it exists today. There are, in round numbers, 470 mi. of 100,000-volt power lines, 20 mi. of 100,000-volt pole lines, 110 mi. of 44,000-volt power lines, 370 mi. of 44,000-volt pole lines and 30 mi. of 11,000-volt pole lines. These lines are exclusive, of course, of the numerous distributing lines of the associated Southern Public Utilities Co., which is the concern retailing energy in the various communities.

Figs. 1 and 3 show the Fishing Creek development from upstream and downstream. The dam and station extend across the river in a straight line, about 1850 ft. long. The dam itself is of 50-ft. maximum height and is of gravity overfall section for the entire length, except where consolidated with the power-house foundation. There is a free spillway of about 1100 ft. and between this and the station is a section with 12 hinged floodgates, between piers, lowering into recesses in the

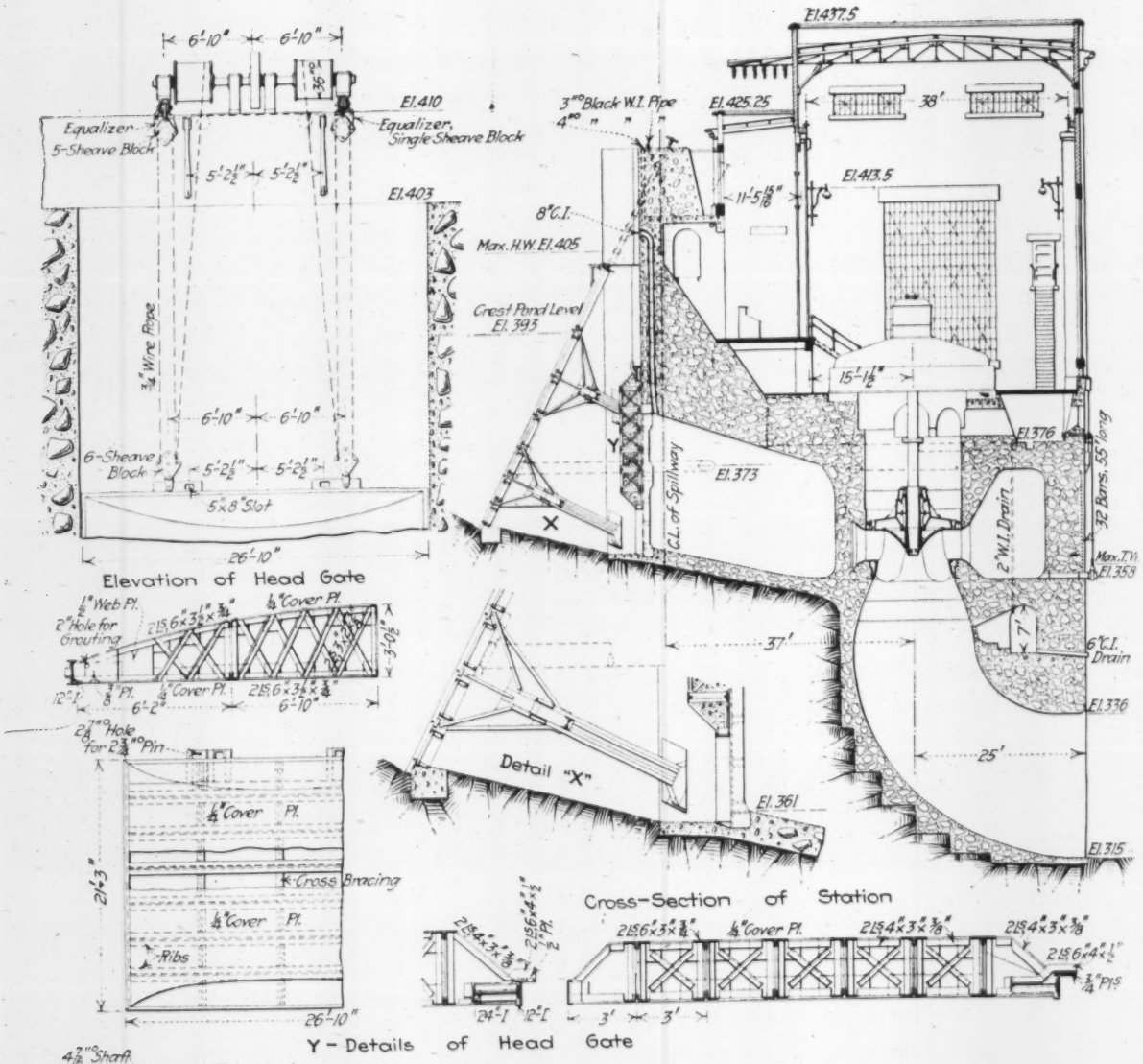


FIG. 2. MAP OF SOUTHERN POWER CO. SYSTEM AND DETAILS OF FISHING CREEK DEVELOPMENT

top of the dam and operated by cables and motor-driven winches (see Figs. 2 and 3). The overall length of the gated spillway is about 192 ft., and the length of free waterway aggregates 120 ft. The dam contains 110,000 cu.yd. of cyclopean concrete.

The power house is 250x40 ft. in plan. The building substructure, draft tubes and turbine scroll cases are combined with the dam at this point. The draft tubes increase from 12-ft. 9-in. circles to 19x37-ft. ellipses. The intakes are 20x26 ft. in section at the headgates. The foundations contain about 40,000 cu.yd. of masonry. The superstructure is a steel frame with brick walls, and the roof is a tar and gravel composition (Barrett specification).

The headgate construction is unusual, as may be seen from Fig. 2. The gate itself is a simple concrete-filled steel frame, weighing complete 216,000 lb. in air and 156,000 lb. submerged. There are no thrust rollers, etc. The gate is lifted by a motor-driven winch with two drums. The weight of the headgates is designed to close them under full operating head. To facilitate raising, a 2-ft. bypass is provided to fill the intake and scroll case, the turbine wickets being built to close tight and allow but slight leakage.

The design of the racks is unusual, as will be seen from Fig. 2. Each rack frame is braced to a pair of inclined steel arches, set with their haunches in niches in the piers separating the intakes. This design is intended to carry full hydrostatic pressure—as when the racks are stopped with driftwood. Also, the racks are intended to be used as stop-log frames, should it ever be necessary to work in the intake or scroll case with the headgate up.

In the power station are five turbines, each built to develop 10,800 hp. at 97.3 r.p.m., under 57-ft. head. The runners are of cast iron in a single piece, 8 ft. high overall and 12 ft. 9 in. in diameter at the band. The rated diameter (midway between hub and band) is 105 in. The runner weighs 58,000 lb. The speed rings are 17 ft. in diameter and 9 ft. high. The wicket gates are of cast steel, are hollow and have a hollow gate spindle. Through the latter, oil is delivered to a bronze bearing in the bottom plate. The guide vanes of the speed ring, outside the wickets, have cored openings through which any water that leaks above the runner and top plate and along the gate stems may pass off into the draft tube. In this way pressure that ordinarily piles up on top of the runner is relieved.

Each wheel carries a 74-pole 7500-kv.-a. 6600-volt generator, with a 95-kw. 250-volt shunt-wound exciter on top. The total load of the revolving part, including water thrust, is 275,000 lb., and it is carried on a spring thrust bearing mounted on a heavy deck above the generator frame. The outside diameter of the stator is 43 ft. 2 in., and this part weighs 77,500 lb. The rotor is 20 ft. in diameter and weighs, with its shaft, 118,000 lb.; its WR^2 is 7,000,000.

Stepping up the voltage from 6600 to 101,200 volts is done outside the power house in an outdoor-type of substation. Transformers and high-tension oil circuit-breakers and disconnecting switches are all of the outdoor type. All the main switches are of remote-control design, operated from a central bench board. There are seven single-phase water-cooled 60-cycle 5500-kv.-a. transformers, in two banks with one spare unit. These are on trucks to facilitate handling and are fitted with the latest equipment in the way of thermometer alarms, breathers, etc.

This development was carried out by the Waterec Power Co., a subsidiary of the Southern Power Co., under W. S. Lee, Vice-President and Chief Engineer, and A. C. Lee, Assistant Chief Engineer. The contractor was the Hardaway Contracting Co., of Columbus, Ga. The turbines and governors were built by S. Morgan Smith Co., of York, Pa.; the generators, exciters, substation equipment and other important pieces of electrical apparatus were made by the General Electric Co., of Schenectady, N. Y.

Statistics of Railway Grade Crossings in the United States are presented in the annual publication of the Bureau of Railway Economics of Washington, D. C., just issued. There are 255,606 grade crossings in the United States, of which only 31,602 are protected by gates, flagmen, or other apparatus. Of the class of grade crossings where one steam railway crosses another, 5303 are protected and 4164 are unprotected. Of grade crossings of steam and electric railways, 2491 are protected and 2215 are unprotected. Of highway grade crossings, 16,000 are protected by gates and flagmen, and 7000 by crossing alarms, and 217,000 have no protection. The elimination of grade crossings makes very slow progress. During 1915 there were eliminated 44 steam railway grade crossings; 17 grade crossings of steam and electric railways, and 466 grade crossings of railways and highways. It should be noted that these statistics cover only railways having annual earnings above $100,000. A great number of grade crossings on short railways of light traffic are therefore not included.

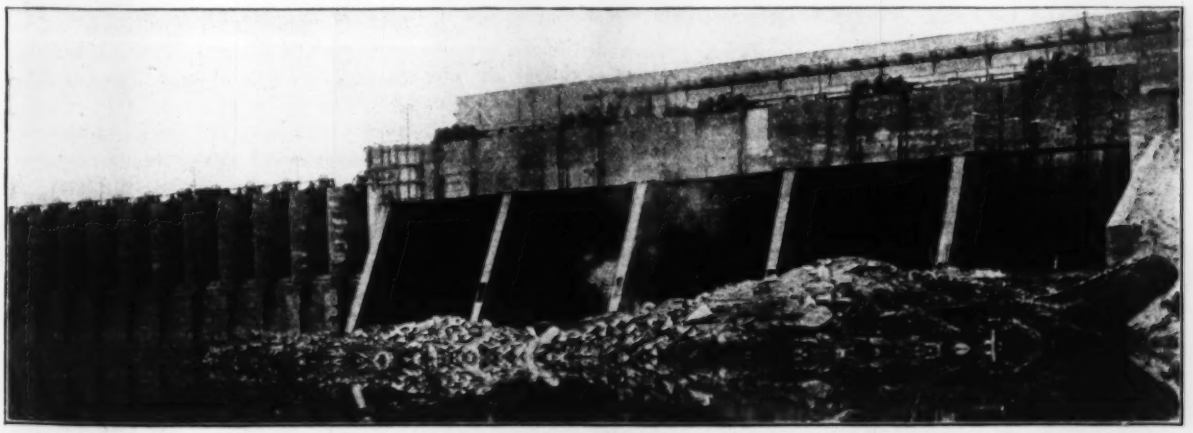


FIG. 3. FISHING CREEK DAM AND STATION DURING CONSTRUCTION
View from upstream on Nov. 12, 1916, showing racks, headgate hoists, floodgate piers and hoists, etc.

The Miami Valley Flood-Protection Work

V—New Features in the Specifications

Specifications for Contract Work Which Have Been Especially Drawn To Secure Good Contractors and Low Cost; Extensive Departure from Precedent; Clearness and Equity; Engineer's Authority Limited

The contract specifications for the $20,000,000 Miami flood protection are as strikingly new and individual as the plans for the work. The specifications have been designed, not compiled. They are an instrument devised to handle the varied work of the huge enterprise effectively, to secure the best contractors, to get lowest contract prices and to produce good work without delays or contention.

The preliminary engineering of the Miami Conservancy District had been so directed as to secure a mass of data on rock, soils, water and other conditions. By means of this survey, many questions had been determined in advance that ordinarily must remain unsettled until long after the contractor begins work. This fact, coupled with the desire to make all the advance information available to bidders, exerted a profound influence on the shaping of the specifications.

The engineers have tried to make the specifications clear, thorough, fair and businesslike, and they seem to have succeeded to a remarkable degree. If in the actual administration these specifications bear out their present promise of efficiency, they will have blazed a new trail through the tangle of contract difficulties.

To indicate a few of the prominent features of these specifications: They give a large amount of advance information, tending to reduce the bidder's uncertainties and risks. They make provision for many of the contractor's requirements, such as camp sites, borrow pits and dumps, thereby eliminating further elements of costly uncertainty. They define the contractor's obligations so comprehensively and precisely that at no time is there room for doubt as to what he must do and what he need not do. They set forth the business relations and procedure in definite and satisfactory manner. They bind the owner to as careful observance of terms as they do the contractor. They provide numerous safeguards for the contractor's interests, limiting the arbitrary power of the engineer; but they arm the engineer with great power of decision and compulsion in those matters where the success of the work, or the welfare of the public, may require that he be free to direct, and to enforce his demands. They call for normal quality of work except where specially high quality is needed, but in these latter instances they set forth the required quality in such plain terms as to insure its being obtained.

Points of interest, though they may be secondary, reside also in the simplicity of the language—that is, the elimination of much complex legal phraseology and other heritages of tradition—and in the great reduction of clauses specifying "the engineer's satisfaction." With respect to the latter, a special campaign was made to eliminate the phrases "approved," "satisfactory," "as directed," "to the engineer's satisfaction," etc. One of the final drafts of the specifications was gone over in detail by two members of the engineering organization who are experienced in heavy construction work, and every instance of these terms was studied to find out whether definite description of a desired result could be substituted. This laborious revision is the more worthy of notice here because its results are likely to be overlooked, since they show only in a negative way.

The specifications are unusually businesslike. In stating time and terms of payment, in specifying results and methods in a measurable way, in providing for successive partial release of surety, in facilitating the adjustment of the final estimate, and in many other ways, their tendency is to establish systematic business relations, largely freed of the personal factor.

A valuable feature is the quick-reference arrangement of the document. It is essentially a self-indexing system, tied and referenced to the unit-price items of the bid.

The Mechanical Arrangement; A Self-Indexing System

The specifications have three divisions: General Conditions, General Specifications and Detail Specifications. The latter division, intended as the primary reference portion, is divided into numbered sections, or "items," 1 to 90, which deal with the separate classes of work included in the contract. Each item corresponds to the bid item bearing the same number, as Item 1, Stream Control at Dams; Item 56, Laying Vitrified Round or Channel Pipe; etc.

Whatever part of the work the contractor may be engaged in, knowing the numbered item of the bid schedule under which he is working he has only to look up the detail-specification item bearing the same number. This gives him at once all the necessary engineering and accounting information, a statement of the kind of work covered by the item, directions for doing the work and the conditions of measurement and payment, or a reference to appropriate paragraph numbers of the General Specifications.

As may be understood herefrom, clauses of general applicability to methods are grouped separately to form the division General Specifications. Sections here included are such as Assistance in Making Tests, Protection of Existing Structures, Embankment (six methods of embankment construction are described and specified in minute detail), Concrete (fine aggregate, coarse aggregate, water, forms, mixing, placing, etc.). Similarly, the relations between the two parties and all matters auxiliary to construction, as Camps, Medical Supervision, Extra Work, Hindrances and Delays, Payments, etc., are covered in the division General Conditions. The clauses of the General Conditions are numbered 0.1 to 0.57, and those of the General Specifications 0.57 to 0.105, which successfuly avoids all confusion with the item numbers of the Detail Specifications.

Individual specifications for each of the separate contracts in the enterprise are prepared from the main or consolidated specifications by simply omitting item para-

graphs for work not included in the particular contract. The numbering is retained unchanged, so that, whatever the contract may be, Item 5 is "Excavation, Soil Stripping," and Item 37 is "Backfilling." This expedient is an important safeguard against mistake, in dealing with a large number of contracts.

With regard to the element of fairness, it is pertinent to state that this was considered vital. Many clauses virtually specify the engineer's fairness. Thus, in the clause empowering the engineer to direct the manner of conducting the work, an added phrase, "in so far as may be necessary to secure the safe and proper progress and quality of the work," was introduced for the purpose of putting the burden of proof on the engineer and limiting his right to dictate. And under the same head the responsibility for preventing interferences between different contractors is placed on the engineer in express terms. Where inspection of work involves damage to such work, the contractor is to be compensated for this damage unless the inspection reveals bad work.

That a great deal of arbitrary power is yet left to the engineer, notwithstanding this desire to be wholly equitable, is to be explained by the possibility that contracts may have to be let to the lowest bidder, according to the underlying law, unless the Conservancy Court sanctions another award.

The district undertakes to furnish the contractor all right-of-way, all camp sites at dams, and ground for borrow and dumping. In consequence it has been possible to state many requirements more specifically than is usual in contracts, and on the other hand certain provisos had to be made for failure of the district to furnish these facilities promptly.

Definitely Limited Authorization for Extra Work

Carefully drawn safeguards surround the subject of extra work. These act as a check against a contractor's possible inclination to regard every instruction given him as cause for a bill for extras. On the other hand, equal care has been taken to point out specifically those cases where a claim of compensation for extra work is admissible. Thus, failure to furnish right-of-way calls for compensation:

> In case of serious delay and loss to the contractor because of failure of the district to furnish right-of-way which in the opinion of the engineer is necessary to the work, the contractor shall be compensated for such loss.

Similarly, when work is stopped by the engineer's direction for any cause other than is specifically authorized in the contract, compensation for extra expense is to be paid.

In general it is provided that extra work (to be ordered in writing by the engineer) shall be paid at actual cost plus 15%, the cost being without overhead. However, if the engineer orders change or increase of plant to promote progress, it is to be considered as regular work done under the contract. Similarly, specific exception is made of night work. Provision is made for claims for damage caused by acts or omissions of the engineer.

In contrast with the individuality of the extra-work clause is the way in which the related matter of changes in plan is disposed of. The right is reserved to the Board of Directors to make such changes as it may elect "in the line, grade, form, location, dimensions, plan or material" of any part. The contractor has no claim (beyond payment at the bid unit prices) except for work done or material furnished that is rendered useless by the change. There is no clause in this section limiting the amount of reduction without compensation for profits, but in this connection the form of bond provides that no alteration shall be made, without the consent of the surety, which will "alter the general character of the work as a whole, or . . . increase the total amount to be paid to the contractor by more than 25%."

How the Time Question Is Handled

The contract lays special stress on time of completion. It segregates from the contract time an initial period agreed upon as the "period of preparation," during which the plant is to be assembled and working forces are to be organized. In computing rate of progress, seasonal weather conditions are taken into account by rating as two working months the winter period from Dec. 1 to Mar. 31, while the remaining calendar months are rated as equivalent to ten working months. The expected winter rate is therefore only two-fifths of the expected summer rate, as measured in ordinary working days.

The contract fixes as liquidated damages for noncompletion at the specified time (or as it may be altered by extensions) a sum made up of two parts, one sufficient to compensate for the expense of employing engineers and inspectors, etc., and the other representing for each month ½% on all money paid to the contractor. These provisions, which put the matter of damages on a mathematical, wholly defensible basis, are considered so fundamentally important that they are embodied in the "agreement," while the further clauses bearing on time are in the specifications.

The contractor must take note of all data and information collected by the engineer and on file for his inspection, and of all adverse conditions; but there is the following important limitation of his responsibility with regard to time:

> It is understood, however, that as to river and weather conditions the contractor shall provide against the most adverse conditions and circumstances which reasonably are to be expected to occur on the average within a 15-year period as shown by past records.

The extensive rainfall and flood researches of the district (see *Engineering News*, Jan. 4, 1917) afford specific information on the magnitude of the average 15-year flood and rainfall.

Extensions of time are specifically declared to be possible, in several different clauses, for delay by legal injunctions (if this unavoidably delays the entire contract and not merely parts thereof), for failure of the district to furnish right-of-way and for other similar reasons.

Measurement and Payment Defined in Precise and Equitable Manner

A novel stipulation applies generally to all measurement:

> Unless specifically so stated in detail in the contract or specifications, no extra measurements, or measurements according to local custom of any kind, shall be allowed in measuring the work under this contract; but only the length, area, solid contents, number, weight or time in standard units, as the case may be, shall be considered.
>
> It is stipulated and agreed that the planimeter shall be considered an instrument of precision adapted to the measurement of areas.

Two interesting pieces of extra allowance of earthwork are in the cutoff trenches and in road construction:

> 6.2 Maintenance During Construction—Should material
> 7.2 wash into a cutoff trench before the placing of em-

bankment, or stony gullies due to wash be formed, such material and stones shall be carefully removed, if directed, and the contractor shall be paid the contract price per cubic yard for material so removed.

Maintenance During Construction—The contractor shall keep the surface of the roads constructed under this contract in good condition, during the life of the contract. When so ordered, he shall fill any depressions caused by settlement or by wear and tear due to use, and he shall be paid therefor at the unit price stipulated for the respective items entering into such repairs.

A still more important provision along the same line is introduced in connection with river excavation for channel improvement:

Payment—Payment for these items will be made in accordance with Section 0.71 of the specifications, entitled "Excavation—Payment," with the following exceptions:

Any material that washes into the cut through no fault of the contractor shall be removed by him at the unit price per yard stipulated for these items.

Some individual points of care to avoid trouble attract notice. Under Borrow Pits, warning is given that borrow will not be estimated as excavation (except in specific cases separately provided for); that pits when abandoned (and there is a similar clause for spoil banks) must be shaped and graded, and, if ordered, topsoiled and grassed; that the shaping is included in the item price, but topsoiling and grassing is paid for as a separate item. Excavation of test pits will be credited as extra work. Controlling any springs on the site of an embankment will be paid for, as regards material used, and excavation.

Doubt as to what is included in a given payment item is dispelled by such clauses as the following for concrete:

Concrete, Prices To Include—Except for cement, reinforcing steel and other metalwork, as provided elsewhere, the unit prices for the different items of concrete shall cover the entire cost of construction thereof, which shall include the cost of materials for fine and coarse aggregates, and of large stones; the cost of all mixing, conveying, placing of concrete and large stones; the cost of damming, bulkheading, pumping, bailing; the cost of preparing foundations, piping or otherwise caring for water, and removing laitance; the cost of grout wash or mortar beds used in building upon old work or on rock, and of coatings for contraction joints; the cost of protecting concrete against frost, floods and injury from other sources; the cost of erecting and removing forms, centers, molds, bracing, landing platforms and scaffolds, and of the lumber, steel, nails, wire and other material used therein; the cost of finishing, patching and wetting; the cost of removing and replacing defective work; and any other work and materials necessary to complete the concrete construction as required by this contract.

But such unit prices shall not include the cost of furnishing cement, the cost of furnishing and placing reinforcing steel, piping, conduits, structural steel, castings and other metal work, which shall be paid for under the items provided therefor.

Even more instructive is the manner in which payment for steel reinforcement is handled:

Payment—The quantity of reinforcing steel to be paid for shall be the number of pounds placed in accordance with the drawings or orders. The unit price stipulated for this item shall include the cost of metal, the royalty, if any, the cost of transporting, cutting, bending, placing, fastening in position, cleaning, protecting and all other labor and materials connected therewith. Waste material, due to the fact that the lengths furnished are longer than necessary, and wires, clips or other devices used for securing the metal shall not be included for payment. The quantity paid for shall include, however, extra metal in authorized laps wherever the lengths required would be unreasonably long for single bars. In determining quantities, except as the engineer may require test weighing on scales, commercial unit weights shall be used.

As already indicated, the contractor must take all risks, including the hazard of weather and flood:

The risks and uncertainties in connection with the work are assumed by the contractor as a part of this contract, and are compensated for in the contract price for the work. The contractor, except as otherwise definitely specified in this contract, shall bear all loss . . . from the action of the elements . . . or from any unexpected conditions.

Damage such as flooding of lands above the permanent dams, however, does not fall on him.

Providing for Hazards and Contingencies

With respect to the riskiest item of weather hazard—namely, that involved in stream control during construction of the dams—the above general clause is reinforced by an unusually specific statement. Payment for stream control is a lump-sum item, plus payment for certain materials by measurement (excavation, embankment, riprap). What this payment covers is set forth very broadly in Section 1.3:

The lump sum . . . shall be considered full compensation for all services, labor, material and equipment and for all the resources of the contractor used for or incidental to the operations under this item and for all risks and damages connected therewith.

Hazards that threaten not the contractor but private parties, are dealt with in a separate clause, relating to emergency work, whose opening paragraph reads:

It is understood by all parties to this contract that unusual conditions may arise on the work which will require that immediate and unusual provisions be made to protect the public from danger of loss or damage due directly or indirectly to the prosecution of the work, and that it is part of the service required of the contractor to make such provisions. The contractor shall use such foresight and shall take such steps and precautions as may be necessary to protect the public from danger of damage or loss of life or property which would result from the interruption of public water-supply or other public service or from the failure of partly completed work.

However, if the engineer finds that sufficient precautions have not been taken, he may direct the work done or have it undertaken by others at the contractor's cost. To protect the contractor against undue charges under this clause, it is provided that the Board of Directors may, for cause, allow him fair compensation.

New Classification in Excavation and Backfill

Excavation is grouped in three classes, depending on material, as has frequently been done in the past. A more precise separation is made in this instance, however, principally because of a material composed of rock interstratified with clay, which occurs in the Miami region. The three classes are defined as follows:

Class 1. Earth—Earth, as a name for excavated material, shall be used to include (except where material is classified as Class 2, Mixed Excavation) all glacial deposit, whether cemented or not, except solid boulders ½ cu.yd. or more in volume; it shall include all alluvial deposits and disintegrated material lying on top of ledge rock and all material of whatever nature not properly included under Class 2 or 3. It shall not include the Cincinnatian formation . . . earth or any material which has been classified on the drawings as Class 2, Mixed Excavation.

Class 2. Mixed Excavation—The term Mixed Excavation, as a name for excavated material, shall be used to include:

The material known geologically as the Cincinnatian formation, which lies under the glacial deposits and consists of thin, approximately horizontal layers of limestone, from a fraction of an inch to a few inches thick, alternated with and embedded in clay, and which may or may not require blasting for its removal; and

Mixtures of any or all materials which, in the opinion of the engineer, it is impracticable to classify as Class 1, Earth, or Class 3, Rock, either because of the character of the material or because of the method used in its removal.

Class 3. Rock—Rock, as a name for excavated material, shall be used to include the solid ledge-rock formation, whenever found (except when classified as Class 2, Mixed Excavation), which is pre-glacial and which can be removed properly

only by means of explosives, barring or wedging or by some other recognized method of quarrying solid rock. It shall also include existing concrete, or masonry with mortar joints, which may be removed under instructions. It shall not include thin layers of limestone embedded in clay, nor cemented gravel, nor any material classified as Class 2, Mixed Excavation.

A distinction is made in the bid schedule and in the items of the Detail Specifications between excavation below mean low water and above this elevation. Items below mean low water (when this is indicated on the plans) are distinguished from those above that level by the suffix *a;* thus, Item 13 is Earth Excavation for Outlet Work, etc., at Dams, but when this excavation is below indicated low water it comes under Item 13a.

For purposes of bidding, excavation is divided into 10 items, differing in location and purpose, which with the above classifications give ample room for varying the price according to cost.

BACKFILL DISTINGUISHED FROM REFILL—The specifications state that excavation includes making the excavation and refilling those portions that may be required. But this refers only to ordinary filling. Puddled or otherwise consolidated refill is designated as backfilling, a separate item in the bid schedule, and as described is to be done by puddling or by rolling or tamping in 6-in. layers.

EMBANKMENT MATERIALS AND METHODS

Six classes of embankment are described, covering the entire range of kind of service and method of construction. They refer respectively to the hydraulic (monitor-and-pump) method; the semihydraulic method (bringing material in by mechanical means, but sluicing it to place by hydraulic streams); the sprinkling and rolling method; and three grades of levee and road embankment. In specifying the material for the dam embankments, there are interesting points in a portion of the controlling clause:

> Where Class A, Class B or Class C embankment is specified, it is the intention that the outer portion of the dam shall be composed of coarse material which shall be permanently stable under a condition of complete saturation. Any material which has a tendency to slough, slide or wash when subjected to any condition which may reasonably be expected to occur will not be acceptable. The center portion of the dam shall be composed of material containing sufficient clay or other finely divided particles to be highly impervious to water. To obtain these results the contractor shall use only carefully selected materials. Where the material from one borrow pit does not contain the requisite coarse and fine particles in the desired proportions, other sources shall be utilized; and if necessary to obtain satisfactory results, more than one class of material shall be deposited at the same time in the same or different portions of the embankment.

The preparation of rock and earth foundations for masonry structures involves a suggestion as to what tools should be used, which well indicates the expected result:

> The surface shall be scrupulously freed from all dirt, gravel, scale, loose fragments or other objectionable substances. Streams of steam, air or water under sufficient pressure, and wire brushes or other effective means, shall be used to accomplish this cleaning. Steam jets or hot water shall be used to thoroughly remove snow, ice or frost, if any be found upon the foundation when it is desired to lay concrete.

WARNING AND ENCOURAGEMENT AS TO USE OF LOCAL MATERIALS

Unusual care is taken in giving the bidder and contractor advance information about the probable availability of certain materials. Thus, in a well-drawn paragraph on riprap there is contained a distinct warning against the use of most of the local stone.

> 58.1 Description—Riprap of required thickness and composed of tough, durable stones of the size to be prescribed shall be placed as designated in the drawings or ordered. Stones placed on or in the slopes of embankments as a result of the grading of embankment material, will not be classed as riprap. The contractor will not be required to place riprap by hand, with the exception of such handwork as is necessary to conform to the specified lines. None of the softer limestone formations found in the locality are acceptable for riprap, and only such of the harder limestone as quarry to acceptable shapes and sizes, and the large boulders, will be satisfactory.

Similar warning is contained in the specification for dry rubble paving. In the specification for concrete aggregate it is stated that, subject to test, the local gravels will be satisfactory for use as coarse aggregate if properly screened and washed, but few or none of the local ledge rocks are satisfactory.

The contractor is not only allowed, but encouraged to use in the construction all material obtained from excavation and the like. *He receives double pay* for such material, once for excavation and once for placing. Thus it will be economical for him to use material from construction rather than to borrow and waste. This clause reads, in part:

> 0.62 Materials Obtained from Construction—Materials from the excavations, or from clearing or stripping or other operations, which are suitable and required, shall be used in the construction, as and where directed or permitted, and shall be paid for according to the class of work in which they are used, in addition to the price paid for original removal, except in the case of embankment material for streets and highways, and of material for refilling excavations, where such refill is not designated to be paid for as backfilling.

He is also specifically given permission to enlarge excavations that do not require lining with concrete, in order to obtain material. Such material, however, is not paid for as excavation.

NOVELTIES IN THE CONCRETE SPECIFICATIONS

The engineers considered that final determination of the concrete mixtures would best be made at the time of construction, or at any rate subsequent to the drafting of the specification and receiving of bids. They therefore provided for varying the mixtures over a range generally from 1:2:4 to 1:3:6. This is made equitable by the expedient of paying for the cement as a separate item; the variation in total aggregate (sand + stone) will be immaterial as between richer and leaner mixtures.

For bidding, concrete is grouped in 11 items of different location or kind. The cement requirements are those of the specifications of the American Society for Testing Materials, published in its 1915 Year Book, with the addition, however, that 20% increase in strength must be shown from 7 to 28 days (1:3 briquettes) and that the tests must show reasonable uniformity of the cement. Reinforcing steel is required to be of the structural-steel grade of billet-steel reinforcement as specified by the American Society for Testing Materials, and must be "twisted or otherwise deformed." If it becomes rusty, only "loose rust scale" is required to be removed.

SAND TESTS AND CONCRETE MIXING

Sand for use in concrete must show a 28-day crushing strength at least equal to standard Ottawa sand, in 1:3 mortar. Limestone screenings will not be acceptable as fine aggregate. For stone, no definite tests are prescribed, but an "acceptable" mixture of sizes between ¼ in. and 2½ in. must be present. Run of crusher or run of bank shall not be used without screening. Water for concrete

must be "reasonably clean and free from oil, acid, strong alkali or vegetable matter."

A carefully worded requirement is made as to mixing:

0.93 Concrete Mixing—All operations incidental to mixing concrete shall proceed with sufficient dispatch to insure the bonding together of the successive batches as a true monolith. Concrete shall be mixed in approved mechanical batch mixers, in batches of suitable size, except that, when permitted, it may be mixed by hand in a thorough and satisfactory manner. In determining proportions of ingredients, 100 lb. of cement shall be considered 1 cu.ft. The coarse and fine aggregates shall be measured separately and uncompacted, in approved measuring boxes. Suitable means shall be provided for controlling and accurately measuring the water. The entire batch shall remain in the mixer not less than 60 sec., and longer if necessary to secure a thoroughly satisfactory mix.

After requirements for depositing, churning, spading and the usual statement of cold-weather precautions, a severe clause for protection of concrete after placing is inserted:

0.100 Concrete, Protection of—The contractor shall not permit walking or working over or upon finished surfaces of concrete until sufficiently hardened. Concrete shall be kept moist for at least four weeks or until covered with earth, and during this time shall be protected from freezing. Every precaution shall be taken to prevent concrete from drying until there is no danger of cracking or crazing due to lack of moisture. To this end concrete surfaces, unless covered with wet canvas or other equally effective material, shall be sprinkled with sufficient frequency to preclude any possibility of drying out. Alternate drying and wetting shall be particularly guarded against. Great care shall be exercised at all times to prevent injury to concrete surfaces which will be exposed in the finished work. The contractor may at any time prior to the final acceptance of the work be required to clean all exposed faces of concrete.

A very moderate demand for surface finish is put into specific terms, so that the contractor may be sure he will not be led into special expense on this account. Its essential portion calls for simply "removing in an approved manner all the rough edges and projections."

The important case of the interior of the discharge conduits is, however, covered in a very different way. Here an absolutely hard, durable, even and continuous concrete surface must be obtained in order to make sure that the high-velocity flow of water cannot do damage. For this purpose, a very rich mixture using specially graded selected aggregates and molded or finished to a true surface is called for, though the finish may be natural (from the forms):

42.1 Description—The lining of the outlet conduits, except as otherwise indicated in the drawings, shall consist of a special grade of concrete, mixed in proportions, by volume, of approximately 1 of cement, 1½ of sand and 2½ of coarse aggregate, the latter to be composed of fragments of granite, trap or other suitable igneous rock approved by the engineer. Such coarse aggregate shall pass through a screen having 1-in. round holes and be retained on a ¼-in. mesh screen. No large stones shall be placed in this class of concrete. As maximum possible density and exceptionally smooth and uniform interior surfaces are essential for the conduit linings, more than ordinary care shall be exercised in building, finishing and securing forms and in proportioning, mixing and placing the concrete, and the contractor shall employ none but skilled labor for this work. Both the fine and the coarse aggregates shall be especially well graded. To secure the proper gradation it may be necessary to separate the coarse aggregate into not more than three sizes and thoroughly remix in such proportions as directed. After placing in the forms, the concrete shall be so manipulated by spading and joggling as to expel entrained air, not only from the concrete, but also from between the face of concrete and the forms. No plastering or patching of concrete surfaces forming the waterway shall be done unless expressly permitted, and if so permitted shall be done in strict accordance with directions. No thin patching or plastering will be permitted, but recesses shall be cut of such shape as to retain the patches and of such depth as to insure their permanency. If required, anchor bolts shall be set in drilled holes, and these and wire mesh or other suitable device embedded in the patch. The contractor shall supply carborundum brick or emery wheels, if necessary, and shall dress all inequalities on the surface of this concrete.

Right To Retain Imperfect Work

In addition to the usual requirement that the contractor must make good defective work irrespective of prior acceptance of this work or material, there is a clause which gives the engineer the right, under certain circumstances, to retain work found to be imperfect. If the imperfect work is not bad enough to require replacement, it may be retained at a reduced price:

0.8 Retaining Imperfect Work—If the contractor shall execute any part of the work defectively, and if the imperfection in the opinion of the engineer shall not be of such magnitude or importance as to necessitate, or be of such nature as to make impracticable or dangerous or undesirable the removal and reconstruction of the imperfect part, then the engineer shall, with the written approval of the board, have the right to make such deduction as may be just and reasonable from the amounts due or to become due the contractor, instead of requiring the imperfect part to be removed and reconstructed.

For example, suppose that a contract for one of the dams be entirely completed at the close of a working season, except that the grassing of the slopes under the item Surface Dressing and Grassing had resulted in a poor stand of grass on a portion of the area. To insist that the contractor correct this imperfection would impose a great hardship on him, as it would mean holding the contract open through the winter and for several months into the following working season. Under the clause quoted, the board could make reasonable deduction for the unsatisfactory grassing, pay the final estimate and close up the contract, attending to the reseeding later at a suitable season. The value of such a clause, under these circumstances, is obvious. It simplifies the carrying out of businesslike methods in many similar instances.

A Few Additional Businesslike Provisions

A remarkable provision that looks to the interests of both parties is made in connection with earthwork for roads. This provision reads as follows:

19.6 Readjusting Grades—Attention is called to the un-
20.6 certainty of ledge-rock elevations, which, owing to the
21.6 nature of the work to be done, cannot be determined in advance. In order to avoid shallow rock excavation, or to obtain sufficient suitable materials for embankments and refills, or for any other purposes, the grades shown on the drawings may be changed or modified at any time by the engineer to obtain the desired results.

The intent to facilitate rather than bind and hamper the contractor is seen in the following paragraph:

Wherever in the specifications or in the drawings standard specifications or other publications are referred to, copies thereof may be found, available for reference, at the office of the chief engineer.

Also, in the following:

In the event of any doubt as to the meaning of any portion of the contract, specifications, drawings, supplementary drawings or instructions of the engineer, the same shall be understood to call for the best types of construction, both as to materials and workmanship, which reasonably can be interpreted.

The contractor is also helped by an important provision in the section governing the procedure in making the final payment. Final payment is to be made by the district before the expiration of 30 days from date of final acceptance by the board, irrespective of claims against the district, provided the contractor submits a detailed list and statement concerning any such claims. In other words, the payment is not held up until all claims are

adjusted, but only until data are submitted by which their adjustment can subsequently be taken up.

The contractor receives interest at 6% on all delayed payments, interest beginning on the tenth day after date of estimate, or in case of the final payment, on the thirtieth day after acceptance of the work by the board.

Authors of the Specifications

The specifications as finally adopted represent largely the work of Arthur E. Morgan, Chief Engineer, and Charles H. Paul, Assistant Chief Engineer; H. S. R. McCurdy also had an active part in their preparation; but the unusual variety of previous experience represented by the large number of engineers engaged upon this project enabled special first-hand knowledge to be utilized on all sections of the specifications. Among those contributing in an important way to the final result are Daniel W. Mead, consulting engineer; J. H. Kimball, O. N. Floyd, G. H. Matthes, Walter M. Smith and A. B. Mayhew. The specifications and form were searchingly reviewed from a legal viewpoint by the attorneys for the district, E. J. B. Schubring, of Madison, Wis., O. B. Brown and John A. McMahon, of Dayton, Ohio.

Evolution of the Flood-Control Project

Immediately after the disastrous flood of March, 1913, a Flood Prevention Committee composed of leading citizens of Dayton, Ohio, began a consideration of ways and means of preventing the recurrence of such a disaster. They employed the Morgan Engineering Co., of Memphis, Tenn., to make all necessary engineering investigations and suggest a plan of procedure. Upon the recommendation of this company, a plan of protection for the whole valley was adopted, a new enabling law was passed by the State Legislature, and under this new law the Miami Conservancy district was established in July, 1915, with its office at Dayton. The directors of the district are E. A. Deeds, of Dayton; Henry M. Allen, of Troy, and Gordon S. Rentschler, of Hamilton. The secretary of the district is Ezra M. Kuhns.

Previous to the legal organization of the district much of the preliminary investigation and general planning was completed, and immediately upon its creation the district took over the whole engineering organization and has carried forward the work to date. As soon as the legal procedure required in the levying of the special assessments against the benefited property can be completed it is expected that contracts will be let and the whole project pushed to rapid completion.

Earth Roads by Day Labor

The building of earth roads by day labor in Jackson County, Minnesota, was decided upon by the County Board in the winter of 1915-16. W. M. Richmond, District Engineer of the State Highway Commission, acted as superintendent and had charge of hiring the men and teams, purchasing the camp equipment, etc.

The equipment was purchased early in the spring of 1916. This included two horse or stable tents 30x24 ft., a dining tent 19x19 ft., a bunk tent 28x18 ft. and an office tent 14x16 ft. There was also the kitchen equipment and sleeping equipment for a camp of 30 men. The kitchen was built of lumber and made in sections put together with hooks and bolts, so as to be easily assembled and moved. The county leased from a railway contractor 18 teams, equipped with harness, at $35 per month, the owner to stand all risks of injury and death. These teams were in service about seven months. No other outfit had to be hired, as the county has its own elevating grader, 10 dump wagons, a 13-ton traction engine and two road graders (or blade machines), also about 12 wheeled scrapers, 12 fresno scrapers and 4 slip scrapers.

The grading outfit consisted of the elevating grader and mormon teams, a dumpman and six to ten wagon teams, depending upon the length of haul. A foreman had charge of this outfit and of the entire camp. The turnpiking or finishing outfit (under the same foreman) included the traction engine, two blade machines and four men. There was also one laborer to remove rock and stones from the road, to throw off any excess sod and to clean out the ends of ditches and culverts that this work covered up.

The culvert crew consisted of a strawboss and four to six laborers, as the work required. This gang also looked after all side ditching and clearing and grubbing of trees. Two teams were used generally to haul the culverts from towns, but when there was a long haul to be made on the road they would go on the grading outfit. Sectional concrete pipe culverts are used for crossing the road, and corrugated metal culverts are used in the farm driveways. The road culverts were installed ahead of the grading outfit, and the others were placed after the blade machines had finished their work.

The turnpiking or finishing crew followed as closely as possible behind the grading outfit, and it was seldom that a mile of graded work was left unfinished. Sometimes the engine and road graders would go ahead and do about a ¼ mi. of finishing while the grading crew were working on a mile stretch, but as soon as this stretch was graded and clear of the outfit the finishing crew would go over it, cleaning up the ditches and shaping the road to the proper crown. In this way each mile of road was opened for travel as the work progressed.

During the 1916 season, over 100,000 cu.yd. of earth was moved with the grading outfit, while the blade-machine outfit did 6 mi. of turnpiking besides all the finishing. For a month early in the season, the engine and blade machines went over the roads already built, clearing out the side ditches and reshaping the top surface.

The men were paid by the month, with board added, except that the laborers were hired by the day. The cook was allowed $5 per week per man, with use of the kitchen and equipment free of charge. He made good pay by boarding the men at this rate, as his only expenses were for coal and food. All of the crews noted above worked 10-hr. shifts.

During 1916 there were 26 mi. of earth road built. They are 24 ft. wide or 38 ft. c. to c. of ditches. The country is rolling, and the roads have maximum grades of 5%. The estimated cost was $1318, but the actual cost was only $1206. The work has proved satisfactory both to the County Board and to the people. It is proposed to build 38 mi. in the same way in 1917 and to finish up in 1918 all the present designated state roads in the county. After all the roads are graded, the county will turn to the work of graveling them, beginning with those which were first graded.

Presidents of Four of the National Engineering Societies

[With Portraits]

SYNOPSIS—Following the annual custom of "Engineering News," now of 24 years' standing, there are published herewith portraits and brief biographies of the presidents of four national engineering societies. The group is this year completed by inclusion of the President of the American Railway Engineering Association in place of the President of the American Institute of Mining Engineers, who will not be elected until later in the month.

George Herndon Pegram; American Society of Civil Engineers

By Richard S. Buck*

George Herndon Pegram was born at Council Bluffs, Iowa, Dec. 29, 1855, the son of Capt. Benjamin Rush Pegram and Mercy Adelaide Robbins Pegram. Captain Pegram subsequently lived in St. Louis, Mo., and was the head of a large steamboat company on the Mississippi River during the Civil War and for some years thereafter, when steamboating on the Mississippi was at its zenith.

Captain Pegram's family, one of the large and well-known Virginia families, originally settled in Dinwiddie County in early colonial days and has since then been liberally represented among notable Americans and especially in all the wars of this country. Edward Pegram, great-great-grandfather of George H. Pegram, commanded a company in the Revolutionary Army. John Pegram, his great-grandfather, was during the War of 1812, a major-general in the volunteer forces of Virginia. During the Civil War two generals, a naval commander and several in minor commands represented the Pegram family in the Confederate forces. On the maternal side, Mr. Pegram's family lived for many generations in Barnstable County, Massachusetts. Richard Sears, a direct progenitor, settled in Plymouth in 1630. Mr. Pegram's maternal great-grandfather served under Washington, and his mother's father fought in the War of 1812.

George H. Pegram was graduated from Washington University, St. Louis, Mo., in 1877, standing at the head of his class. On graduation he entered upon active professional work, becoming one of the engineers engaged in the construction of the Utah & Northern Ry., of Idaho. In the following year he was appointed chief assistant engineer to C. Shaler Smith, one of the most noted of bridge engineers. Two years later he became chief engineer of the Edge Moor Bridge Co. He occupied this position until 1886, when he resigned and made a tour of Europe, having long determined that when he reached the age of 30 he would lay aside all business and devote at least a year to travel, study and recreation.

On his return from Europe he established himself as a consulting engineer in New York City. In 1889 he became consulting engineer of the Missouri Pacific Ry., but resigned this position in 1893 to become chief engineer of the Union Pacific System. During the construction of the plants of the Pioneer Electric Power Co., of Ogden and Salt Lake City, he was also consulting engineer of that corporation.

He became chief engineer of the Manhattan Elevated Ry., New York City, in 1898 and later of its successor, the Interborough Rapid Transit Co.; also of the Rapid Transit Subway Construction Co. in 1905, and of the New York Railways Co. in 1912, which positions he still holds.

He designed and effected the very extensive reinforcement of practically all the old Manhattan elevated-railway structures, which has deferred indefinitely their renewal. He designed and built the third-tracking work of the Manhattan elevated system; and as chief engineer for the contractor, he had charge of the construction of the East River tunnel between the Battery and Brooklyn Borough Hall, and of six sections of the new subways, including the loop under Battery Park and the Diagonal Station at 42nd St. and Park Ave.

This work of construction and reconstruction of the New York transit lines has rarely included anything striking or spectacular from the point of view of the casual observer; but no engineering enterprise ever undertaken has perhaps contained such a multiplicity of complex problems, nor more serious elements of danger, which could be successfully met only by the highest order of engineering skill and sleepless vigilance. Notwithstanding this and the further fact that the enormous traffic of the system has had to be constantly maintained, often under most trying conditions, no serious accident involving injury or loss of life to the public has been attributable to the work under Mr. Pegram's charge.

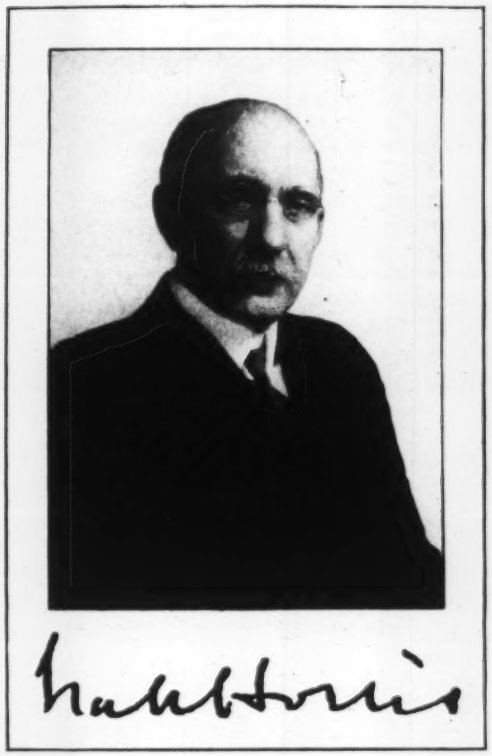
While Mr. Pegram's *magnum opus* has been in connection with the New York transit systems, many other notable works have been performed by him, such as the invention of the Pegram truss, the design of the Kansas City Elevated R.R., the design and construction of the combined highway and railway bridge over the Arkansas River at Fort Smith, and the design of the trainshed of the Union Station at St. Louis.

Mr. Pegram is a past-president of the Technical Society of Omaha and of the Alumni Association of Washington University, which institution in 1905 bestowed on him the honorary degree of master of arts. He has been a director and vice-president of the American Society of Civil Engineers and has served on important special committees of that society. He is a member of the Engineers' Club and of the Railroad Club, of New York City.

Mr. Pegram was married on Sept. 8, 1897, to Miss Jessie Merrielees Crawford, daughter of Dugald Crawford, of St. Louis, Mo.

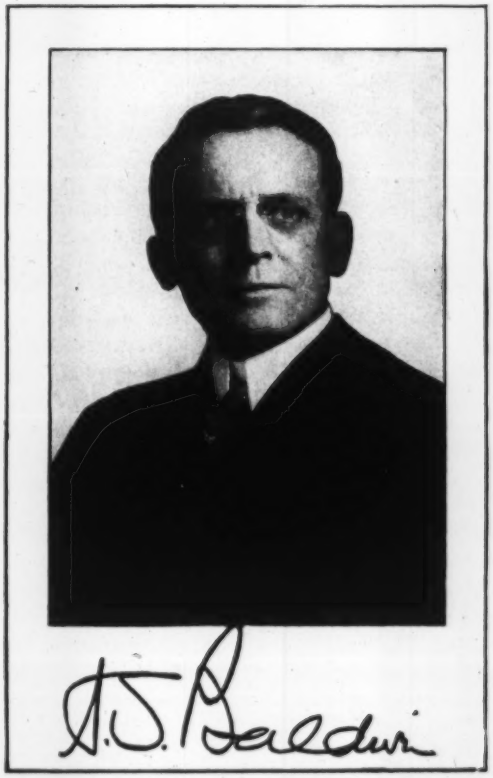
Despite the many and exacting duties of his position, Mr. Pegram has maintained an active and effective interest in general engineering development and has a broad and pleasant circle of professional and social acquaintances.

*Consulting Engineer, New York City.



PRESIDENT OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

PRESIDENT OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS



PRESIDENT OF THE AMERICAN RAILWAY ENGINEERING ASSOCIATION

PRESIDENT OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

THE PRESIDENTS OF FOUR GREAT NATIONAL ENGINEERING SOCIETIES

Ira Nelson Hollis; American Society of Mechanical Engineers

By M. E. Cooley*

"Brotherhood of all engineers and their united action in any service that will be for the good of our country"—a splendid motto, worthy and characteristic of the new president of the American Society of Mechanical Engineers. With the anticipated coöperation of the presidents of other national societies, engineers may be expected to behold their profession in a broader aspect and in a new relation to the world which they serve. And with their characteristic energy they may speedily create for themselves a field of greater usefulness with corresponding prestige and emoluments. To such a prayer all engineers will say Amen!

March 7, 1856, and Mooresville, Ind., among low mountains called the "Knobs," were the time and place of the birth of Ira N. Hollis. New Albany, six miles away, was his home from 1858 to 1868. The family then moved to Louisville, Ky. The Hollises, originally English, moved from Berkeley County, Virginia, to Jefferson County, Kentucky, soon after the Revolution. Lewis, Ira N. Hollis' grandfather, had 19 children, all of whom grew up; and Ephraim J., his father, had four, a son and three daughters. The grandfather fought in the battle of Tippecanoe, and the father served four years as an officer in the Civil War, ending in Sherman's march to the sea. His mother, Mary Kerns, also of English origin, moved into Ohio from Pennsylvania. She was the daughter of the contractor who built the Ohio & Mississippi (now Baltimore & Ohio) R.R., west of Seymour, Ind.

Starting in a private school in New Albany, Hollis continued his education in the grammar and high schools of Louisville. In his senior year he won the second of the two gold medals given by the city for high scholarship. Louis D. Brandeis, now a justice of the United States Supreme Court, won the first. Obliged to go to work, he was apprenticed to Webster's machine shop and foundry in New Albany, where river-steamboat engines were built. Health failing after a year, he found lighter employment as a clerk on the transfer platform of the Louisville & Nashville R.R. freight depot in Louisville. Six months later he went to Memphis as bookkeeper in a cotton commission house.

It was in the spring of 1874, when at the age of 18, that Hollis saw a way open to complete his education. The four-year course for engineers had just been established at the United States Naval Academy, to which 25 cadets were to be appointed annually on competitive examination. Thomas Scott, president of the Pennsylvania R.R., furnished him a pass to Annapolis and return, and Mr. Keane, manager of the Louisville Hotel, financed him for the trip.

Turned away on arrival at the academy for want of credentials, he proceeded to Washington, where, watching his opportunity, he appeared unannounced before the Secretary of the Navy. An hour's talk with the secretary sufficed to secure a permit, armed with which Hollis returned to Annapolis and took the examination with 75 others from all sections of the country. This was early in September.

It was a disheartened boy who returned home after the examinations, fearing he had failed miserably. There had been little time to prepare except on the train, and physics had not been included in his high-school course. Imagine his surprise a few days later to receive orders to report at Annapolis on Oct. 1, and his joy on arrival to find that he had passed No. 1.

At Annapolis, Hollis early took the lead, which he maintained, and graduated No. 1 in 1878. Not only that, but he found time to pursue advanced courses in several subjects and did considerable reading. In his first class year he was appointed chief cadet officer of the Engineer Division. His interest in athletics was such that, had his strength permitted, he would gladly have shared scholarship with physical prowess. Desiring to follow naval architecture, he applied for orders to go abroad for study, but the department's policy in this regard was not established until the following year. Then and for many years thereafter the two graduates with highest standing received the coveted honor.

On Sept. 20, 1878, Hollis reported for duty on the "Quinnebaug," fitting out at the Norfolk navy yard. She was to cruise in European waters, if on her trial trip she made 14 knots. Her 10 boilers of the "powder keg" type, built for 80 lb. pressure, were among the first steel boilers in the navy. Her engines, originally low pressure, had been compounded by bushing one of the cylinders, but the copper piping had for the most part been left unchanged.

In assigning stations among the four watch officers in the Engineer Division the boilers fell to Hollis. That trial trip with its foaming boilers and squirting feed pipes was a nightmare, but the ship went to Europe. She sailed without Hollis, however, who was detained in the naval hospital with typhoid and joined the ship later at Malaga. This cruise lasted 28 months. His next cruise, of 19 months, was on the "Hartford," starting in June, 1885. He served on the "Charleston" 26 months, from December, 1889, his last sea service being three months on the "Richmond."

On returning from Europe, Hollis was ordered, Sept. 2, 1881, to Union College, Schenectady, N. Y., where he served for 34 months as professor of mechanical engineering under the Act of 1879, which authorized the detail of engineer officers of the navy to colleges to teach steam engineering and iron-ship building. His next shore duty was with the Navy Advisory Board for nine months, from June 30, 1884, during the building of the White Squadron.

He was on inspection duty for 30 months, from Apr. 15, 1887, in San Francisco, while the "Charleston" was being built at the Union Iron Works. Following his cruise in the "Charleston," he was ordered to the Bureau of Steam Engineering in August, 1892, where he served for one year. In October he delivered a course of lectures at the Naval War College, Newport, R. I., on "Coal Endurance and Machinery of the New Cruisers," later published in the *Journal* of the American Society of Naval Engineers (Vol. IV, No. 4). He resigned, Sept. 30, 1893, to accept the professorship of engineering at Harvard University.

Graduating as a cadet engineer, Hollis was promoted to assistant engineer, June 20, 1880, and to passed as-

*Dean of the Colleges of Engineering and Architecture, University of Michigan, Ann Arbor, Mich.

sistant engineer, at the age of 33, Feb. 19, 1889. It had taken 14½ years to reach the grade of junior lieutenant, a discouraging prospect for young men.

At least twice Hollis may be said to have rendered notable service to the navy. The first was connected with the filibuster "Itata" during the Chilean insurrection in 1891. After her chase by the "Charleston" and surrender in Iquique, a board of survey set a time limit of from six to eight weeks to put her machinery in order to return to San Diego. Hollis, assisted by two other officers and 50 men from the "San Francisco," "Baltimore" and "Charleston," did the work in five days and then brought the "Itata" north without stop at an average speed of 8¾ knots. This accomplishment brought a very complimentary letter from Admiral McCann to the Navy Department. An interesting account of the "Chase of the Itata" was published in the *Journal* of the American Society of Naval Engineers (Vol. IV., p. 360).

But his greatest service to the navy was as a civilian. It had to do with the Personnel Bill, enacted into law Mar. 3, 1899. It ended the line and staff fight of many years' standing. In the early summer of 1897 Professor Hollis, on being asked to contribute to the fund for carrying on the fight in Congress, went to Washington and proposed a plan to Secretary of the Navy Long, which led to the appointment of the Personnel Board, with Colonel Roosevelt, then Assistant Secretary of the Navy, as chairman.

The important features of the plan were: (1) The amalgamation of the line and engineers; (2) the selection of engineers from the line to do engineering duty and to remain as a technical corps; (3) regulation of the flow of promotion; (4) some kind of general staff. There were some 13 points in all. The subject will be found treated quite fully in the *Atlantic Monthly* for September, 1897, and in the *Army and Navy Journal* from Aug. 21 on.

Secretary Long reported favorably to Congress, Jan. 13, 1898; the bill passed the House, Jan. 18, 1899, and the Senate, Feb. 17. Two features advocated by Professor Hollis were omitted—namely, the technical corps and the general staff. But these have since been formed, or are about to be. Notwithstanding his important part in this reorganization work, Professor Hollis would not wish it understood that he did more than help start it and assist when called on in perfecting the bill then being drawn up.

During his 20 years at Harvard, Professor Hollis accomplished many things. An interesting account of them will be found in the *Harvard Magazine* for June, 1913. He took a prominent part in the life of the college and was highly esteemed. The attendance in engineering increased many fold. Largely through his efforts Pierce Hall and its equipment were provided in 1901, and the summer school at Squam Lake, N. H. The Harvard Union and the stadium became realities largely through his efforts. For eight years, from the fall of 1895, six as chairman, he served on the Athletic Committee. Sports were moved from Holmes Field to a new site created out of tide-washed barrens. This became Soldier's Field, now most completely equipped for every branch of college athletics.

It was while Professor Hollis was on the Athletic Committee that a scholarship requirement was imposed on all who would engage in intercollegiate games. This restriction took practical form in the joint rules between Harvard and Yale, which because of keen rivalry required two years for their enactment.

Professor Hollis' work at Harvard was largely constructive. Long-established conventions had to be faced, and it was only by his admirable tact that he handled successfully many problems bound about by traditional red tape. His strong character and keen sense of right and wrong have, by long years of discipline tempered by a quick appreciation of humor, made him unusually effective. Those who have been his colleagues and students testify abundantly to his remarkably fruitful life while there.

He was offered and accepted the presidency of Worcester Polytechnic Institute in 1913. Already in his three years at Worcester he has established himself in the affections alike of its governing board, faculty and student body.

President Hollis holds the honorary degrees of A.M., from Harvard, 1899; L.H.D., from Union, 1899; and Sc.D., from Pittsburgh, 1912. He is a fellow of the American Academy of Arts and Sciences and a member of the American Society of Naval Engineers, American Society of Naval Architects and Marine Engineers, Boston Society of Civil Engineers and the Society for the Promotion of Engineering Education. He is the author of "War College Lectures," 1892; "History of the Frigate 'Constitution'," 1900; and has been a liberal contributor to engineering journals and various other publications.

He was married Aug. 22, 1894, to Caroline Lorman, of Detroit, a graduate of the University of Michigan. They have four children: Jannette Ralston, a senior at Bryn Mawr; Oliver Nelson, a senior at Harvard; Elinor Vernon, soon to enter Vassar; and Carolyn.

Harold Winthrop Buck; American Institute of Electrical Engineers

By W. L. R. Emmet*

Harold Winthrop Buck comes of a family very well known in New York. He is the son of Albert H. Buck, a well-known surgeon and artist in New York; and his grandfather, Gurdon Buck, was also a surgeon, famous in his time. His mother, Laura Abbott Buck, is a member of a distinguished New England family; her father was John S. C. Abbott, the well known historian.

Harold W. Buck was born on May 7, 1873. He inherited a good constitution, and he has developed it by a love of outdoor life. He was graduated at Yale University with the degree of bachelor of philosophy in 1894 and from Columbia University in 1895, with the degree of electrical engineer.

His first engineering work was with the General Electric Co., at Schenectady, where he began as a student in the testing department in 1895. During his two years of apprenticeship he showed originality in several matters, which attracted attention. He was associated with two others in the invention of a method for making in an electric furnace, from clay, an abrasive that was

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equivalent to corundum or emery. This process was sold to the Norton Emery Co., of Worcester, Mass., and with certain developments and modifications has grown into a very important industry.

In 1897 he became assistant to the writer, then engineer of the lighting department of the General Electric Co. At that time an active campaign was being carried on in Schenectady for the introduction of alternating current for general distribution. The uses of alternating current before that time were very primitive, and its adoption in large parallel operating systems involved a very rapid and extensive development of inventions, designs and constructions. This campaign involved the expenditure of great sums for radically new apparatus of many types and many operating problems that had not been encountered before. It was carried through within two or three years without important mistakes and constituted a noteworthy step in the great electrical development. Mr. Buck was in the thick of this campaign and rendered fine service in it. He had a good mental grasp of the situation and had the courage to do things when many others had not.

As a result of his activities during this critical time Mr. Buck was, in 1900, notwithstanding his youth, recommended for the important position of chief engineer of the Niagara Falls Power Co., which was then in the most important and active stage of its development. This position covered also the electrical engineering for the many allied interests, including the Canadian Niagara Power Co., which was then just beginning its development, and the Power and Conduit Co., of Buffalo. Mr. Buck held this position until 1907 and during that period was intimately associated with the many interesting electrical activities of that most remarkable industrial district.

In 1907, in association with M. A. Viele and F. O. Blackwell, Mr. Buck joined the corporation of Viele, Blackwell & Buck, consulting engineers, New York City, of which he is vice-president. From its inception the corporation has played an important part in the design and construction of many famous power developments both in the United States and Canada, including such systems as the Great Western Power Co., the Appalachian Power Co., Schenectady Power Co., East Creek Electric Light and Power Co., the Northern Ontario Light and Power Co., Northern Canada Power Co., the California Electric Generating Co., and others of equal importance.

In addition to his activities as vice-president of Viele, Blackwell & Buck, Mr. Buck is also connected with the General Utilities Corporation. He has taken out patents on a number of useful electrical devices and, in conjunction with E. M. Hewlett, developed and introduced the suspension-insulator system now in general use on most high-tension transmission lines, it being indeed the key to successful operation with the voltages now used.

Mr. Buck has written extensively upon engineering and electrical subjects for technical publications, and he is author of a number of papers which are to be found in the *Proceedings* of the American Institute of Electrical Engineers.

Mr. Buck was married in 1902 to Miss Charlotte R. Porter, of Niagara Falls, a daughter of a distinguished family whose name has been associated with Niagara Falls from an early day.

A. Stuart Baldwin; American Railway Engineering Association

By Isham Randolph*

A winning combination in this world is that of character, brains, experience and pleasing personality—with few exceptions it means success.

Inheritance gave Archibald Stuart Baldwin the brains; precept and high example formed his character; pursuit of his chosen profession through more years than, perhaps, he is willing to own up to, brought him the ripe experience that makes his judgment worth while; and innate courtesy and kindness have endowed his pleasing address.

His engineering experience began as an axman. But he was capable of better things than clearing a path through the underbrush and making, toting and driving stakes. His party chief soon found it out and varied the monotony of existence by having his axman rest himself in the evenings, making computations, profiles and doing other odd jobs not ordinarily in the axman curriculum.

The head chainman of this survey party was a mountaineer who had worked with surveying parties for a long time and had acquired rare ability as a natural locator of railroad routes in rough country. When he parted with young Baldwin, the mountaineer expressed his pleasure at Baldwin's having obtained a better job and proceeded to counsel him, saying, "So many engineers fall down when they try to do things they can't do; don't you never do that again; don't you never try to be an axman again; don't you never try to do nothin' you can't do."

Mr. Baldwin has kept that advice. He has never tried to "do nothin' that he can't do." He has been doing things that he could do and doing them so well that his advancement has been from responsibility to responsibility, until today he is chief engineer of the Illinois Central R.R.—and he has never had any pull, nor has he made stepping stones of his fellowmen. His accomplished work, wherever he has been, has created the steps by which he has mounted to responsibility, respect and esteem.

He was born in Winchester, Va., Sept. 28, 1861—one might say in the very midst of the Civil War country. His father was Dr. Robert F. Baldwin. After a good elementary education at the Shenandoah Valley Academy, Winchester, and at the Staunton Military Academy, Staunton, Va., A. Stuart Baldwin started in 1879 to learn civil engineering with the engineer corps of the Richmond & Allegheny R.R. (now a part of the Chesapeake & Ohio Ry.).

From the position of rodman with the railway company he stepped to that of assistant engineer and subsequently engineer of the Iron and Steel Works Association of Virginia. In 1882 he returned to railway work as a draftsman and assistant engineer with the Baltimore & Ohio R.R. on the Philadelphia extension. During 1885 and 1886 he was principal assistant engineer of the Missouri River bridge of the Chicago, Milwaukee & St. Paul Ry., at Kansas City, Mo. Then for a time he was resident engineer of the Louisville, St. Louis & Nashville R.R.

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In 1887 he began 14 years of service with the Louisville & Nashville R.R., during which time he was assistant engineer and later roadmaster. The Illinois Central R.R. obtained his services in 1901 as principal assistant engineer. He was soon after made engineer of construction, and since 1905 he has been chief engineer.

Mr. Baldwin is a member of the American Society of Civil Engineers, Western Society of Engineers, Chicago Engineers Club and of the Society of Cincinnati of Virginia. He married Miss Mattie Frazier, of Staunton, Va., Dec. 19, 1883.

Concrete Bridges with Through Arches

Two reinforced-concrete arch bridges built recently in Illinois are of the Marsh "rainbow-arch" type, having through spans in which the deck is above the level of the spring line, while its middle portion is suspended from the arches. One of these bridges is over the Fox River, near Crystal Lake, Ill., and the other is over the Little Wabash River, at Carmi, Ill.

The special feature of this type of concrete bridge is that it permits longitudinal expansion and contraction movements of the deck without affecting the arches. This is provided for by making the deck slab independent of the arch ribs at the two points where its plane intersects them and supporting it at each of these points upon a cross-girder or floorbeam built integrally with the arches. The floor slab is practically monolithic, but has a chance to deflect between the floorbeams, as there is a construction joint over the center of each beam and the reinforcing in the top of the slab does not extend over the beams, although the lower reinforcing is continuous.

The design is considered to be economical and is of particular advantage where the headway is insufficient for a deck-arch bridge or where the flood line approaches to the level of the bridge floor. This type of bridge is the invention of J. B. Marsh, of Des Moines, Iowa, and was patented by him in 1912. He is represented in Illinois and other central states by the Westcott Engineering Co., of Chicago, and this company was associated with him in the design of the two bridges noted above. Both bridges were built by the J. J. O'Heron Co., of Chicago.

The Crystal Lake bridge has five spans with a clear distance of 80 ft. between piers. It carries a roadway 18 ft. wide. The arches are segmental, with a rise of 16 ft. and a radius of 58 ft. on the lower side. Each rib is 22 in. wide, with a depth of 26 in. at the crown and 35 in. at the floor intersection. They are spaced 18 ft. apart in the clear. The steel reinforcement in each arch is a box-lattice girder composed of four flange angles with lacing bars on all four sides. To this girder are attached the hangers (composed of four angles) the lower ends of which are connected by pairs of transverse angles embedded in the floorbeams. At the ends the arch thrust is taken by the side walls of the hollow abutments, but at the piers the steel ribs of adjacent spans are connected so as to form a continuous structure.

The end floorbeams are built into the arch ribs and are integral with them. The deck of each span is a 7-in. slab, built integrally with the intermediate floorbeams (carried by the hangers), but independently of the end floorbeams and abutments (or piers). Thus the slab can move horizontally without any effect upon the movements of the ribs. Each pier consists of a pair of pedestals connected by a curtain wall. The abutments are of hollow box form, with transverse struts. Pile foundations are used, the ground being gravel and clay. This bridge was built in 1915 and 1916 and cost about $20,000.

FIG. 1. RAINBOW-ARCH CONCRETE BRIDGE AT CARMI, ILL.

The Carmi bridge has three arch spans of 90 ft. between piers, with a rise of 18 ft. and a radius of 65 ft. 3 in. on the under side. It has an 18-ft. roadway and 6-ft. sidewalk between the arches. The bridge is high, with its deck 43 ft. above the bed of the stream. The Little Wabash River is subject to very sudden rises, the water level rising sometimes 40 ft. in three days after a heavy rain. The rainbow type of through-arch span is of particular advantage under such conditions, as it gives a maximum clearance for the waterway and does not cause such obstruction (to drift and water) as would be caused by a deck-arch span. This bridge was built in 1916 and cost about $21,960.

The method of construction of the rainbow-arch bridges is to place the structural steel reinforcing of the

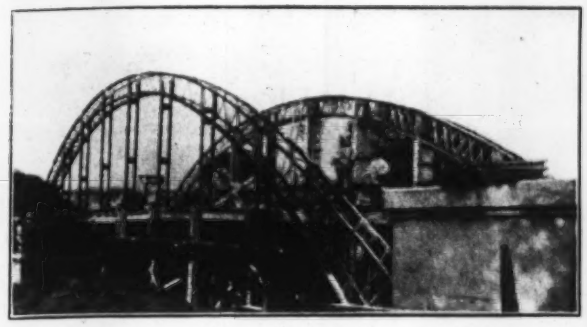

FIG. 3. FALSEWORK FOR CARMI BRIDGE

ribs first and connect them rigidly in place with struts, floorbeams and hangers. The formwork is then built around the steel reinforcing. The reinforcing for the arched ribs is composed of four angles laced on four sides and with the back of the angles placed outward, which gives the maximum value for the metal. The angles can be made heavy enough to carry the forms and the formwork of the bridge, including the weight of the concrete. Where this method will be cheaper than to support the structure on piles in the bed of the river, it is not necessary to put in piles and supporting falsework at all, so that after the piers are built there is no danger from floods washing out the falsework and carrying away the bridge during construction.

The concrete in each case was a 1:2:4 mix, using gravel with a maximum size of 1¼ in. The forms were of wood, except for the parapet walls. For these latter, special pressed-steel forms for balusters were used in combination with wood forms for the base and cap. These forms were built up in sections to fit and were used repeatedly. The concrete was then poured in place. The mix was 1:1½:3, with the coarse aggregate ½ in. in size. The rail required no special treatment or finish after the forms were removed. No surface treatment was employed to remove form marks, etc.; but where necessary to improve the appearance, the surfaces of the arch ribs, posts or piers were rubbed to an even finish.

The bridges were designed for a live-load of 125 lb. per sq.ft. on the roadway and sidewalk, and the floor system for a 20-ton road roller, according to the standard specification of the Illinois State Highway Department. The stresses in concrete were what governed, as the load carried by the steel does not exceed 16,000 lb. per sq.in.

The rainbow-arch designs for these two bridges were placed in competition with the design prepared by the State Highway Department, and the bids for these were in competition with those of contractors bidding on the latter designs. In accordance with the Tice Law in Illinois the design had to meet the approval of the State Highway Department and had to be of sufficient strength to carry the loading provided for in the department's specifications.

Water Meters and Meter Rates in San Francisco, Calif., have been the subject of much commotion of late. It appears that the Spring Valley Water Co. began a rapid extension of its meter system on July 1, 1916, with the intention of setting 25,000 meters on residence services within a year. Subsequently, it began to bill for metered water at the rates fixed by the San Francisco Board of Supervisors (city council) on June 29, 1915. Since then the control of water rates in San Francisco has been vested in the State Railroad Commission. Allegations that the meter rates are excessive brought the matter before the commisison, which seems to have held that the city ordinance did not provide rates for meters on all domestic services and that since the commission had not established meter rates the company was without authority to collect such rates from domestic consumers generally. The commission has just renewed an order, issued in November, directing the company to bill consumers at flat rates, but to read the meters monthly and to notify customers of the readings. This order is to hold until Feb. 1. What is to happen after that date is not clear.

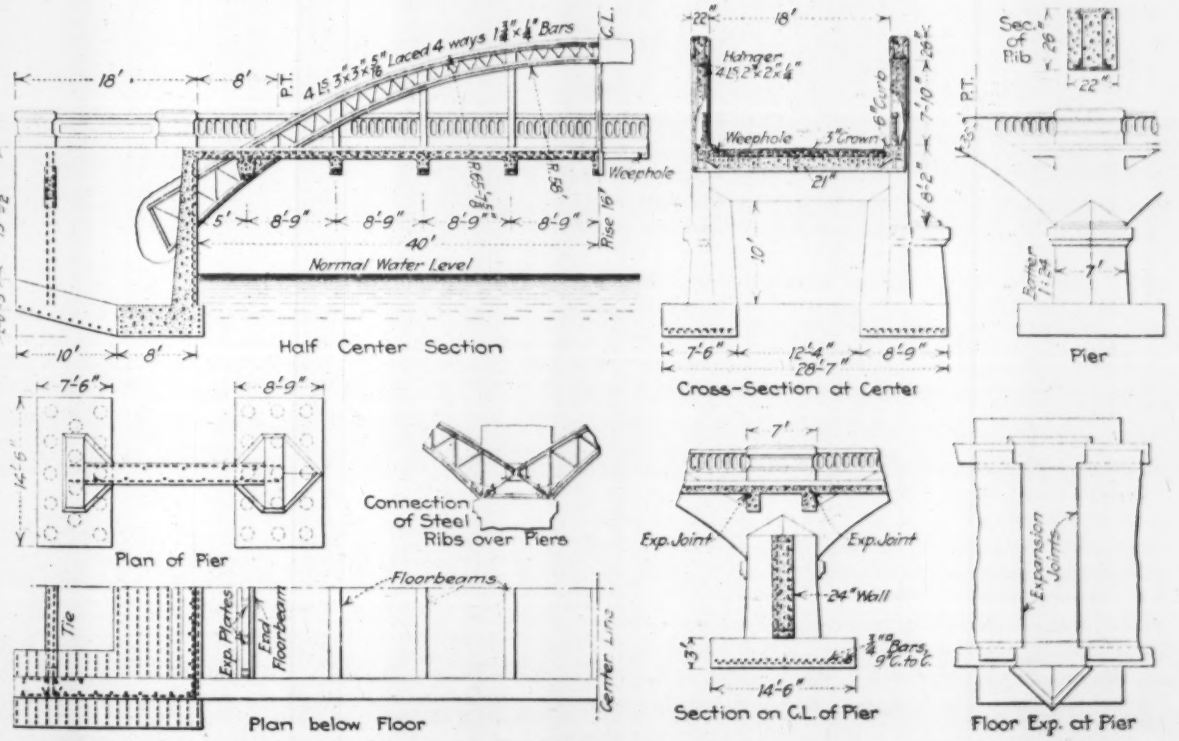

FIG. 2. DETAILS OF RAINBOW-ARCH CONCRETE BRIDGE OVER THE FOX RIVER AT CRYSTAL LAKE, ILL.

Engineering Literature

Merriman's Hydraulics Revised

REVIEWED BY ROBERT E. HORTON*

TREATISE ON HYDRAULICS—By Mansfield Merriman, M. Am. Soc. C. E., with the assistance of Thaddeus Merriman, M. Am. Soc. C. E. Tenth edition, revised. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. x + 565; illustrated. $4 net.

Inasmuch as Merriman's "Treatise on Hydraulics" is widely known and earlier editions have been reviewed in this journal from time to time, a complete review of the text will not now be attempted. The great advances in hydraulics since the publication of the first edition of Merriman's book in 1889 are exemplified in some degree by the growth in the book itself. At the present time there are at least seven leading lines of hydraulic practice, including water-power development, river improvement and navigation, water-supply and purification, drainage and irrigation, sewerage and sewage disposal, naval hydro-mechanics, and pumping and hydraulic machinery. The hydraulic features of each of these subjects receive treatment in Merriman's book to the extent, at least, that the salient facts and principles are briefly set forth.

As pointed out by the late George W. Rafter in his review of the eighth edition of this work (*Engineering News*, June 18, 1903), a distinguishing characteristic of Merriman's "Hydraulics" is lucidity of style. In the tenth edition the practice of presenting a full explanation and less purely mathematical discussion is carried even farther than in earlier editions. The smooth, lucid, easy style gives to the demonstrations of formulas a simplicity and naturalness that is very pleasing—likewise easily forgotten. The demonstrations, while less thorny than those presented in more formal mathematical language, are not lacking in probative force. Easy reading makes the book attractive, both to the average student and to the practicing engineer who wishes to brush up on a knotty problem without at the same time being obliged to refurbish his calculus any more than is necessary. The manner in which the author has succeeded in removing the "demon" from his demonstrations is largely by clear verbal explanation of each step as he proceeds. This has the effect of keeping the hydraulics rather than the mathematics of the subject constantly before the reader.

The criticism that has occurred to the writer in the practical use of several editions of Merriman's book is one common to many textbooks, in that it has been written somewhat too largely from the idealistic standpoint. The use of the term standard as applied to weirs and orifices is unfortunate. Other forms of orifices—for example, those constructed with properly rounded edges—will give results well within the limits of accuracy demanded in practice and at the same time resist ice, débris and hard usage much better than a so-called standard orifice. The practicing engineer is called upon to calculate the flow through hydraulic structures of a wide variety of forms. A young engineer whose training has been academic along these lines is likely to be floored and give up when he first encounters a problem that looks irregular; or if given the results obtained in practical conditions, he is likely to condemn them as worthless.

From the standpoint of the use of the book as a text the conditions are quite different. The textbook sets up principles and ideals to be sought after, even though they may not always be obtainable. It is easier to handle the differences between ideal and practical conditions in the classroom than in a textbook.

Among new features of the present edition are the introduction of Biel's formula for flow in pipes and channels, more modern discussion of the design and practice in relation to the so-called Francis type turbines and a general tendency to broader view and rounding out of subjects in pure hydraulics, which will undoubtedly be found to overcome in some degree the misconception that might arise from the too academical treatment in earlier editions.

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Management and Cost Problems

REVIEWED BY ROSSITER R. POTTER*

INDUSTRIAL LEADERSHIP—By H. L. Gantt. [Addresses delivered in the Page Lecture Series, 1915, before the Senior Class of the Sheffield Scientific School, Yale University.] New Haven, Conn.: Yale University Press. Cloth; 5x8 in.; pp. xii + 128; 6 charts. $1 net, postpaid.

THE PREDETERMINATION OF TRUE COSTS AND RELATIVELY TRUE SELLING PRICES—By Frederic A. Parkhurst, M. E., Organizing Engineer. New York: John Wiley & Sons. Cloth; 6x9 in.; pp. viii + 96; 30 illustrations. $1.25 net.

The five chapters that make up Mr. Gantt's interesting book are taken from a series of lectures given by him before the senior class of the Sheffield Scientific School. The author expresses the belief that through the observance of correct principles a system of industrialism can be developed under the democratic form of government which will be even more effective than anything possible under autocracy. The first chapter sets forth that proper leadership involves consistent remuneration of workmen on a basis of higher pay for more and better work, the elimination of bluff as a factor of business administration, a realization that business administration is simply the administration of human affairs or the handling of men, and selection of industrial leaders by a process that will bring to the front individuals who are really best qualified for such responsibility.

Chapter II, on training workmen, emphasizes the importance of equality of opportunity. In regard to vocational training through the public schools the author believes it preferable for the state to assume responsibility for general industrial training only, leaving the more specific training in a given vocation to the industries themselves. In the latter part of this chapter

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Mr. Gantt slides easily into an exposition of his favorite topic, "task work," which is continued in Chapters III and IV, dealing respectively with the principles and results of this system. Chapter V discusses the relationship of production and sales effort and makes some mention of modern cost-keeping systems. The author approves the plan of charging to the profit-and-loss account as a separate item the daily expense for idle equipment, instead of spreading this expense on the cost of the product and thereby losing sight of its true nature. The book abounds with pithy statements of what are made to appear as self-evident facts, and it should edify any reader interested in modern industrial developments.

Cost-keeping methods are discussed in Mr. Parkhurst's book with particular attention to their use for determining proper selling prices. The first three chapters outline a system for obtaining the information from which the costs are to be ascertained, including the costs of direct labor and material. Special emphasis is laid upon positive control of the sources of information, such as workmen's job tickets. Chapters IV and V take up the problem of indirect costs and their intelligent distribution. The author favors a differential process-rate method for the distribution of burden and agrees with Mr. Gantt in believing that "undistributed burden" should be separately charged to loss and gain.

There is a brief chapter on estimating, which explains the details of a system installed by the author for a company making different kinds of machine tools, dies, etc., and finally a chapter on the different ways of expressing the rate of profit. The author seems to prefer, for general purposes, the basis of profit per productive hour. The author's general method of presenting the subject is by showing typical printed forms and describing their use and purpose. The forms shown apply especially to foundries and to machine shops. The book might be used, by one previously well grounded in the principles of cost keeping, as a guide for arranging the details of a cost system.

Lubricating Oils

REVIEWED BY JOHN J. FLATHER*

LUBRICATING ENGINEERS' HANDBOOK: A Reference Book of Data, Tables and General Information for the Use of Lubricating Engineers, Oil Salesmen, Operating Engineers, Mill and Power-Plant Superintendents and Machinery Designers—By John Rome Battle, B. S. in M. E. Philadelphia, Penn.: J. B. Lippincott Co. Cloth; 6x9 in.; pp. 333; 114 illustrations. $4 net.

This book has been written by a mechanical engineer who, as stated in the preface, has been associated with the oil business for a number of years. It consists of an exhaustive compilation of useful data and general information relating to the manufacture, selection and use of oils for lubricating purposes, with especial reference to the needs of oil salesmen, operating engineers, mill and power-plant superintendents, machine designers, purchasing agents and others who may have occasion to use or select oils and greases for lubrication.

The treatment is largely descriptive rather than scientifically technical; and it is to be regretted that so little space is devoted to a most important part of the subject—namely, the chemistry of lubricants—although the author has injected a lot of extraneous material that has little bearing on the subject of lubrication and merely adds to the bulk of the volume.

Among the subjects treated are friction, description and effect; theory of lubrication; petroleum and other lubricants and greases; refining, "cracking" and other processes; oil and grease tests, viscosity, friction-testing machines, steam engines and turbines; electrical-engineering data; lubrication of bearings and steam cylinders; the steam-engine indicator and its use.

The lubrication of a great variety of specific classes of machines is discussed, and in many cases this is accompanied by a description of the machinery under consideration. This includes air compressors, automobiles, Diesel gas engines, baking machinery, coal machinery, electric street cars, passenger and freight elevators, flour-mill machinery, ice-making and refrigerating machinery, internal-combustion engines of the explosive type, marine engines, mining machinery, motors and dynamos, printing machinery, pneumatic tools, railway locomotives and cars, rolling mills, textile machinery, steam turbines, waterwheels and wire drawing.

The cost of lubrication is also discussed, and the subject of purchase by specification is presented all too briefly. In this connection the author states:

> If specifications are desired, they should not be too closely written. Their purpose should be to secure a satisfactory oil for fulfilling certain conditions, at the lowest competitive prices, and should not be written with the view of excluding oils made from crudes, other than that of the tested sample. An exactly stated gravity, viscosity and flash will pin all bidders to very narrow limits. Gravity is of no importance. Lubrication depends upon viscosity and its characteristic variations.

Halsey's Handbook Enlarged

HANDBOOK FOR MACHINE DESIGNERS, SHOPMEN AND DRAFTSMEN—By Frederick A. Halsey, B. M. E., M. Am. Soc. M. E. New York: McGraw-Hill Book Co., Inc. Second edition. Cloth; 9x11 in.; pp. xii + 561; illustrated $5 net.

The first edition of Mr. Halsey's deskbook (it was not really a handbook) was a prize for all those mechanical engineers who delight in the acquisition of useful data in convenient form; and it was a working companion much appreciated by hundreds of designers. The second edition, of course, is all that and more. The object of the original work was to rescue from comparative oblivion the best of the vast amount of data and suggestions that regularly appear in current mechanical journals. When the first volume was printed, the author noted that the work was incomplete and that he hoped to fill the gaps in subsequent issues.

The appearance of this second edition testifies to the industry of the author and his interested readers, for some 80 topics have either been added or conspicuously expanded. It would be impossible to name them here, but their range is seen from the following: Thrust, knife-edge and roller bearings, strength of spur and herring-bone gears, design of skew bevel gears and friction drives, capacity of horizontal cylindrical tanks, discharge of weirs, standard pipe tables, cutting speeds of tools, power consumed by machines, hardness tests, heat-treatment of steel, physical properties of carbon and alloy steels, and various new mathematical tables.

Comparatively little has been dropped. Looking at the book as it stands today, it is seen that the expansion of the title to include shopmen is warranted, though the great wealth of material still will be most appreciated by designers.

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Textbook on Mining

REVIEWED BY G. M. BUTLER*

ELEMENTS OF MINING—By George J. Young, M. Am. Inst. M. E. New York: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. xiii + 628; 271 illustrations. $5 net.

The author states that his aim has been to give the reader of this book a comprehensive view of mining. In keeping with this aim he has covered every phase of the industry from prospecting, through boring, drilling, rock breaking, transportation and hoisting, mine drainage, ventilation and illumination, support of mine workings, open-pit and alluvial mining, mine development and underground methods; he has even included chapters on mine organization and operation, mine accounting, accidents and miners' diseases and the examination of mineral deposits. In fact, mining law seems to be the only matter affecting the interests of miners that has not been presented.

As a textbook for students this work will probably be favorably received and widely used. In fact, it is doubtful whether any other book on mining covers the subject in quite so satisfactory a fashion. It seems unfortunate, however, that the discussion of mining equipment and of many types of mine machinery has been handled with such brevity. The chapter on transportation and hoisting, for instance, covers but 12 pages, and practically all of the matter there presented is of a theoretical nature. The author justifies the omissions to which reference has just been made by stating that the publishers contemplate issuing a separate book covering the subject of mine equipment; but few instructors or students will view with equanimity the necessity of using two textbooks when one might have been made to serve the purpose as well.

The subjects of rock drilling and breaking, support of mine workings, mine development and underground methods are handled especially well, but one looks in vain for a discussion of the problems encountered in relining shafts.

It is regrettable that data on costs and the amount of work accomplished under typical conditions have not been made more complete, and that where given the sources quoted are often so old as to be almost worthless. For instance, Dr. Henry M. Payne, of New York, in a personal letter dated Jan. 11, states that from his long experience with Keystone drills he would place the average rate of drilling per day at under 10 ft. rather than 10 to 25 ft., as stated at the bottom of p. 35; and that, on an average, it requires 11 cu.ft. of water to move 1 cu.ft. of gravel through sluices, instead of 20 cu.ft. of water, as stated on p. 74. He also writes, in referring to hydraulic mining in Alaska, that the LaGrange costs during the past year were 2½c. per cu.yd., while the Klondike costs were 5c. per cu.yd. This is in strong contrast to the figures given at the bottom of p. 376. He further says that the company with which he is connected is dredging gravel in Alaska at a cost of from 14 to 15c. per cu.yd., which is less than a third of the figures quoted on p. 384.

Outside of the features mentioned, the book is so satisfactory that it seems undesirable to suggest further criticisms of minor details lest an erroneous impression be conveyed. However, a mineralogist will hardly fail to notice that the definition of a mineral, given on p. 1, will apply with equal truth to native gold and a potato.

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Government Highway Literature

Three recent bulletins of the United States Office of Public Roads and Rural Engineering are of interest to highway engineers. One of these is of a more popular nature—"Economic Surveys of County Highway Improvements"—and has received wide publicity in the daily papers throughout the country. It purports to be "a compilation and analysis of data in eight selected counties, showing comparative financial burdens and economic benefits resulting from highway improvement during a period of years." It is consciously or unconsciously an argument for highway improvement and will prove of value to popular good-roads orators in this capacity.

As the basis of estimate for actual highway projects this bulletin must be used with caution. For instance, great stress has been laid on the increase in farm-land values on account of the improved roads, the argument of course being to show that all this increase was derived from highway improvement. This neglects the fact that farm-land values have increased tremendously throughout the length and breadth of the country during the last five years, and this on account of the great increase in the selling price of farm products and the general prosperity of the farmer, as well as on account of improved roads. That farms on the main roads (which are always the ones first improved) should increase in value more and faster than farms on back roads is a foregone conclusion.

The effect of road improvement on land values in Spotsylvania County, Virginia, is arrived at in this wise: A record was kept of the selling values of 35 farms located on improved roads. These show an average increase in five years of 70.2%. To prove that this increase was due to improved roads and not to other causes, three farms "stated by competent authorities to be typical values on unimproved roads" are picked out and the average price quoted to show that this is far below the average of the 35 farms on improved roads! This is typical of the reasoning under this heading throughout the booklet.

It has also been attempted to show the effect of road improvement on traffic development. These data are based largely on statistics of railway freight shipments to and from the several counties, on field observations of average wagon loads before and after road improvement, and on traffic censuses taken infrequently for periods of a week or ten days at a time. From these, tables of annual ton mileage and total saving, on the basis of tonnage hauled after road improvements, have been computed and some impressive figures arrived at, such for instance as $150,000 for the gross annual saving under this head in Spotsylvania County alone. While containing much valuable material for road economists, it is obvious that these figures are arrived at by many broad assumptions that should be most thoroughly investigated and analyzed before applying them generally.

The description of how the roadwork in the various counties was financed and the economic results of those methods of financing form a valuable and instructive part of the booklet, which on the whole is a welcome addition to good-roads literature. While it may fall short of being of any great practical value to the engineer-economist, it is a beginning along a line of

-tudy and investigation that all highway engineers, or for that matter all public-works engineers, will do well to -mulate.

The other two bulletins referred to in the opening paragraph are "Methods for the Examination of Bituminous-Road Materials" and "Progress Reports of Experiments in Dust Prevention and Road Preservation." The first is a valuable manual of laboratory practice, and the second an interesting description of the present status of many bituminous-road experiments, most of them in the South.

Heating and Ventilating Buildings

REVIEWED BY D. D. KIMBALL*

MECHANICAL EQUIPMENT OF BUILDINGS: A Reference Book for Engineers and Architects—By Louis Allen Harding, B. S., M. E., M. Am. Soc. M. E.; and Arthur Cutts Willard, S. B., formerly Assistant Professor of Mechanical Engineering, George Washington University, and Sanitary and Heating Engineer, United States War Department. Vol. I: Heating and Ventilating. New York: John Wiley & Sons. Leather; 7x9 in.; pp. 615; illustrated. $4 net.

The authors have produced an admirable text and reference book on the subject of heating and ventilation of buildings. It appears to be the most uptodate and complete book yet published upon this subject. It contains many original and valuable tables and charts and a number of interesting and helpful manufacturers' charts and tables. To quote from the preface:

> The object of the authors is to produce a reference book for engineers and architects which will contain sufficient theoretical and commercial data for use in the designing room, and at the same time serve to show the student of this subject the relation between the theoretical principles involved and their practical application to actual problems.

It would appear that the second object of the book has been reached more fully than in the case of any previous book on this subject, but it is doubtful if the book will find any real place in the designing room, evidencing, as it does, too much of the atmosphere of the laboratory and experimental room and too little of experience in practical designing and construction to serve conveniently in an architect's or engineer's drafting room.

After dealing with heat and its measurement and with water, steam and air, heat transmission, fuels and combustion, the authors take up the various systems of heating and elements of heating plants. Air conditioning and related subjects are placed between hot-blast and exhaust-steam heating. Central-station or district heating is considered. The final chapter considers equipment cost, plans and specifications.

While dealing fully with the theory of the art, the book falls short, as already stated, on the practical work of the heating and ventilating engineer. The chapter on "Heat Transmission of Building Construction" is most complete and interesting and alone makes the book worth its price. Very interesting also are the discussion and data on inclosed radiators.

In the chapter on "Ventilation, Air Analysis and Ventilation Laws" more emphasis appears to be laid upon the importance of humidity than any scientific data available would seem to warrant, while no mention is made of "air movement," which recent research seems to point toward as a most important factor in ventilation.

Another interesting chapter is that on "Exhaust-Steam Heating." The steam and electric load curves of various types of buildings are valuable. However, the author's estimate of the value of exhaust steam for heating is none too high.

The final chapter ("Plans, Specifications and Cost of Equipment") is much too brief. Even with the limitations noted the book is a good one and should be owned by every engineer and student of heating and ventilation.

*Of Richard D. Kimball Co., 15 West 38th St., New York City.

Population Figures

ESTIMATES OF POPULATION OF THE UNITED STATES, 1910-1916, Including Results of the State Enumerations Made in 1915—Washington, D. C.: Department of Commerce, Bureau of the Census. Bulletin 133. Paper; 9x12 in.; pp. 46.

Besides population estimates for the United States and the several states, figures are given for all municipalities having populations of 8000 or more on Apr. 15, 1916. In the tables just named the figures include for each place its land area in acres on July 1, 1915, its United States Census populations on Apr. 15, 1910, and June 1, 1900, and population estimates as of June 1 for each of the seven years from 1910 to 1916 inclusive. In these tables the cities are listed alphabetically by states arranged in the same way. In another table population estimates only for the seven years are given for each place of 25,000 estimated population or more in 1916, the arrangement being from greatest to least. The intercensal state census figures give state and county totals for a number of states for 1915, 1905 and 1895 and corresponding figures for places of 5000 and upward in 1915.

Useful Bridge Information

BRIDGE MANUAL: Containing General Information and Instructions—Prepared under direction of John H. Lewis, State Engineer. Salem, Ore.: State Highway Commission. Bulletin No. 3. Paper; 5x7 in.; pp. 154; illustrated.

While intended primarily for the use of the county courts in Oregon in all matters pertaining to construction, maintenance and repair of bridges and culverts, this manual, according to its preface, has been prepared for distribution to various county roadmasters, surveyors, supervisors, etc., in an effort to standardize somewhat the practice throughout the state in the construction of bridges and culverts.

The execution of the project is admirable. It should be useful not only to the persons named, but it should also be of great assistance to bridge engineers everywhere. While of course there is much of purely local interest in the pamphlet, the pages on the construction and design of bridges contain matter not always to be found in standard bridge treatises. For instance, there are outlined the steps in bridge construction, beginning with a selection of the site, the survey, the plans and specifications, letting the contracts, supervision, etc. There are many useful hints on methods of exploring for foundation and instructions as to features of general layout.

In the inspection of bridges a score sheet is given which indicates all the items that should be investigated in ordinary bridge inspection. The relative value of different types of small bridges, estimating curves for different types of bridges and the discussion of painting, all add to the value of the text. Finally, there is a summary of bridge legislation in other states than Oregon, which makes the book of value elsewhere.

Posthumous Edition of Stillman

ENGINEERING CHEMISTRY: A Manual of Qualitative Chemical Analysis for the Use of Students, Chemists and Engineers. By Thomas B. Stillman, M. Sc., Ph. D., Member, American Electro-Chemical Society. Fifth edition. Easton, Penn.: Chemical Publishing Co. Cloth; 6x9 in.; pp. viii + 760; 150 illustrations. $5.

The death of Dr. Stillman, in August, 1915, halted the completion of the fifth edition of his well-known work on engineering chemistry. But the revision was well under way, and his sons have now completed the project. The work on the whole has been very well executed, so that the volume is reasonably up to date and can hardly fail to hold its place as an authoritative manual for the physical and chemical examination of the more used materials of engineering.

The new edition shows drastic rearrangement. The new sequence of topics is more logical, perhaps, though that is quite secondary in a book largely used for specific reference. The thoroughness of the revision is obvious; one can turn to hardly any section and not immediately see the changes. Chief among the longer discussions remaining little altered are those on water and paper examinations. Many of the shorter items, of course, are held intact.

There are extensive additions on the following topics, among others: Determination of sulphur in coal, sampling and analysis of fuels, calorific determinations, specifications for coke, sampling of iron ores, specifications for alloys, examination of portland cement, field testing of concrete, laboratory examination of road-making stones, flue-gas analysis, analysis of combustible gases, pyrometry, analysis of white pigments, turpentine and shellac.

The general method of procedure has been to discard those parts of the older edition which time has shown to be of lesser service. This condensation allows room for the inclusion of recent developments in examination methods, etc. About the best example of this sort of revision is seen in the handling of the old section on asphalt, to allow a large addition of material on bituminous road-making products, wood paving blocks, creosote oils, etc. A similar condensation is marked in dealing with the examination of lubricating oils, where space has been provided to let in new notes on testing of the most modern products, like internal-combustion-motor oils, greases, fuel oils, linseed oil, etc.

Steam Engineering Simplified

STEAM POWER—By C. F. Hirshfield, M. M. E., Professor of Power Engineering, and T. C. Ulbricht, M. E., M. M. E., Assoc. M. Am. Soc. M. E., formerly Instructor, Department of Power Engineering, Sibley College, Cornell University. New York: John Wiley & Sons. [Wiley Technical Series.] Cloth; 5x8 in.; pp. viii + 420; 232 illustrations. $2 net.

The great majority of attempts to popularize steam-engineering texts is marked by the neglect of thermodynamics and deeper theory. The authors of this little book have jumped out of the rut and boldly attempted to lay bare some of the physical concepts of the inner details of steam-power practice. The extent of their success will surprise many mechanical engineers who have held that heavy reliance on mathematics is essential.

The authors, going no farther than algebraic processes for their tools, have enabled non-mechanic.' engineers and practical mechanics of limited education to penetrate as far as temperature-entropy relations, the Rankine cycle, etc., and to approach the theory of steam-turbine design. They have showed so much ability in the execution of this task that many teachers will regret that they did not have the hardihood to go one step farther and try to visualize entropy itself—for entropy, the abstract, still remains the big rock of discouragement in popular thermodynamic discussions.

The book opens with a short review of elementary physics—briefly discussing matter, energy, work, heat, temperature and power. It describes the properties of steam and the action of the ideal reciprocating engine, leading up to the complete- and partial-expansion theoretical working cycles. Entropy diagrams are explained (entropy, however, remaining an abstract intangible "property") and their practical employment described. The practicalities of the real steam engine are contrasted with the expectations from the ideal; effects of condensation, compression, clearance, etc., are noted, and actual types of mechanical-engine structures are pictured. The indicator diagram and its value have an important place, and this is followed by sections on compounding, slide-valve gears, on Corliss, poppet-valve and "una-flow" designs, etc. After steam turbines, condensers are taken up. Fuel-combustion processes, properties of fuels, details of leading types of furnaces and boilers complete the work.

Taylor and Thompson Revised

A TREATISE ON CONCRETE, PLAIN AND REINFORCED. Materials, Construction and Design of Concrete and Reinforced Concrete, with chapters by R. Feret, William B. Fuller, Frank P. McKibben and Spencer B. Newberry—By Frederick W. Taylor and Sanford E. Thompson, M. Am. Soc. C. E., Consulting Engineer. New York: John Wiley & Sons, Inc. Third edition. Cloth; 6x9 in.; pp. xx + 885; 262 illustrations. $5 net.

The third edition of this standard work on concrete brings the discussion of the material down to the end of 1916. According to the preface, the entire volume has been revised and largely rewritten. The chapter on reinforced concrete has been divided into three chapters, giving respectively the theory, tests and the design. In the chapter on building construction, modern details and the methods of handling design in drafting rooms are added. A chapter on beam bridges has been written. The various revisions in practice brought about by the new specifications for cement and for concrete adopted in 1916 are incorporated in the book wherever such incorporation is necessary.

Taylor and Thompson's "Concrete" has a field all its own. It combines probably better than any other American book a discussion of material, design and construction. Being brought down to date, it is now doubly useful.

Minor City-Planning Competition

CITY RESIDENTIAL LAND DEVELOPMENT: Competitive Plans for Subdividing a Typical Quarter-Section of Land in the Outskirts of Chicago—Edited by Alfred B. Yeomans, Landscape Architect. Chicago, Ill.: University of Chicago Press. Cloth; 9x12 in.; pp. 138; illustrated. $3 net; postage extra; weight, 3 lb.

Belated though it is in publication, this report on a minor city-planning competition held in 1913 by the City Club, of Chicago, is a most interesting and instructive volume. Each of many plans entered in the competition is described and illustrated by the competitor. There is a brief report by the Jury of Award and a series of reviews of the plans, from various pens. The volume will

repay careful study by engineers, architects, landscape architects, landowners and real-estate men having to do with the laying out of city residential areas, particularly flat areas without water frontage. The editor and publisher have done their work well.

Some of the many ways an engineer can help in giving public streets a pleasing appearance are shown by text and views in a pamphlet entitled "A Civic Duty for Engineers," by S. E. Doane, chief engineer, National Lamp Works, General Electric Co., reprinted from the *Journal* of the Cleveland Engineering Society by the National Lamp Co., Cleveland, Ohio. The address given in the pamphlet was delivered in December, 1915, before a joint meeting of the society just named and the Cleveland section of the American Institute of Electrical Engineers. Some of the views show lamp poles and brackets, but other street furnishings are shown as well as various buildings.

NEW PUBLICATIONS

[So far as possible the name of each publisher of books or pamphlets listed in these columns is given in each entry. If the book or pamphlet is for sale and the price is known by the editor, the price is stated in each entry. Where no price is given it does not necessarily follow that the book or pamphlet can be obtained without cost. Many, but not all, of the pamphlets, however, can be secured without cost, at least by inclosing postage. Persons who are in doubt as to the means to be pursued to obtain copies of the publications listed in these columns should apply for information to the stated publisher, or in case of books or papers privately printed, then to the author or other person indicated in the notice.]

ARKANSAS DEPARTMENT OF STATE LANDS, HIGHWAYS AND IMPROVEMENTS: Annual Report, 1915-16—Little Rock, Ark.: State Highway Commission. Paper; 6x9 in.; pp. 127; illustrated.

THE AMERICAN PETROLEUM INDUSTRY—By Raymond Foss Bacon, Director, and Allen Hamor, Assistant Director of the Mellon Institute of Industrial Research of the University of Pittsburgh. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in. Vol. I; pp. x + 446; 155 illustrations. Special chapters by F. G. Clapp, Roswell H. Johnson, J. P. Cappeau and L. G. Huntley. Vol. II; pp vi + 447-963; 173 illustrations. $10 a set.

ARITHMETIC FOR ENGINEERS: Including Simple Algebra, Mensuration, Logarithms, Graphs and the Slide Rule—By Charles B. Clapham, Lecturer in Engineering and Elementary Mathematics at the University of London, Goldsmiths' College. New York: E. P. Dutton & Co. Cloth; 6x9 in.; pp. xi + 436; 149 illustrations. $3 net.

CALCULUS—By Herman W. March, Ph.D., and Henry C. Wolff, Ph.D., Assistant Professors of Mathematics, University of Wisconsin. New York: McGraw-Hill Book Co., Inc. Cloth; 6x8 in.; pp. xvi + 360; 125 illustrations. $2.

CONDENSED REPORT OF THE AMERICAN UNIFORM BOILER CODE CONGRESS, Washington, D. C., December, 1916, Held Under the Auspices of the Industrial Commission of Ohio—Erie, Penn.: The American Uniform Boiler Law Society. Paper; 8x11 in.; pp. 87.

ELEMENTARY CAMS—By Franklin DeRonde Furman, M. Am. Soc. M. E. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. vi + 90; 69 illustrations. $1.25.

ENGLISH AND ENGINEERING: A Volume of Essays for English Classes in Engineering Schools—Edited by Frank Aydelotte, Professor of English in the Massachusetts Institute of Technology. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. xix + 390. $1.50 net.

HARD WATER AND HEALTH—By Frank Leslie Rector, B.S., M.D. New York: A. R. Elliott Publishing Co. Reprinted from the New York "Medical Journal." Paper; 5x8 in.; pp. 13.

The author concludes "that the weight of authoritative evidence is in favor of the use of a natural water containing a moderate amount of mineral, at least enough to avoid the flatness in taste of distilled and soft waters." A list of references is given.

THE INDUSTRIAL AND ARTISTIC TECHNOLOGY OF PAINT AND VARNISH—By Alvah Horton Sabin, M.S., M. Am. Soc. M. E. New York: John Wiley & Sons, Inc. Second edition, thoroughly revised. Cloth; 6x9 in.; pp. x + 473; illustrated. $3.50.

IOWA ENGINEERING SOCIETY—Proceedings for 1916. Iowa City, Iowa: The Society. Paper; 6x9 in.; pp. 164. 50c.

LABOR DISPUTES AND PUBLIC SERVICE CORPORATIONS: Proceedings of Academy of Political Science in the City of New York—New York: Columbia University. Vol. VII, No. 1 (January, 1917). Paper; 6x10 in.; pp. iv + 189. $1.50, paper; $2, cloth.

LECTURES ON LEVELING: A Practical Course of Instruction Adapted for the Use of Engineering and Survey Students, Planters, Miners and Others in the East—By V. J. Martin, Assoc. M. Inst. C. E., of the Public Works Department, Federated Malay States. Singapore, Straits Settlements: Kelly & Walsh, Ltd. Cloth; 6x9 in.; pp. iv + 131; illustrated.

A MANUAL OF FIELD ASTRONOMY—By Andrew H. Holt, Instructor in Civil Engineering in the College of Applied Science of the State University of Iowa. New York: John Wiley & Sons, Inc. Leather; 4x7 in.; pp. x + 128; illustrated. $1.25 net.

MANUFACTURING COSTS AND ACCOUNTS—By A. Hamilton Church. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. viii + 452; 139 illustrations. $5 net.

THE "MECHANICAL WORLD" POCKET DIARY AND YEAR BOOK FOR 1917: A Collection of Useful Engineering Notes, Rules, Tables and Data. Manchester, England: Emmott & Co., Ltd. Baltimore, Md.: The Norman, Remington Co. Cloth; 4x6 in.; pp. 332; 87 illustrations. 40c., postpaid, from Baltimore house named.

MONTANA STATE ENGINEER AND CAREY LAND ACT BOARD: Report for 1915-16—Helena, Mont.: A. W. Mahon, State Engineer. Paper; 7x10 in.; pp. 94; illustrated.

OPERATION OF GAS WORKS—By Walter M. Russell, Jun., American Institute of Chemical Engineers. New York: McGraw-Hill Book Co., Inc. Cloth; 6x9 in.; pp. x + 209; 76 illustrations. $2 net.

PRINCIPLES OF AMERICAN STATE ADMINISTRATION—By John Mabry Mathews, Ph.D., Assistant Professor of Political Science in the University of Illinois. New York: D. Appleton & Co. Cloth; 6x9 in.; pp. xiii + 534. $2.50 net.

SELLING YOUR SERVICES—New York: The Sales Service Co. Paper; 6x8 in.; pp. 176. $1.

STATE ENGINEER OF IDAHO: Report for 1915-16—Boise, Idaho: J. H. Smith, State Engineer. Paper; 6x9 in.; pp. 47; illustrated.

STATE ENGINEER OF WYOMING: Report for 1915-16—Cheyenne, Wyo.: J. B. True, State Engineer. Also Results of Investigations by the United States Geological Survey in coöperation with the State Engineer. Paper; 6x9 in.; pp. 379; illustrated.

STATE GOVERNMENT IN THE UNITED STATES—By Arthur N. Holcombe, Assistant Professor of Government in Harvard University. New York: The Macmillan Co. Cloth; 6x9 in.; pp. xiii + 498. $2.25.

STATISTICS OF NEW JERSEY PUBLIC UTILITIES, 1915—Trenton, N. J.: Public Utility Commissioners. Part I. Paper; 6x9 in.; pp. 80.

STATISTICS OF RAILWAYS, 1905-1915—Washington, D. C.: Bureau of Railway Economics. Paper; 6x9 in.; pp. 57.

SUMMARY REPORT OF THE MINES BRANCH OF THE DEPARTMENT OF MINES: December, 1915—Ottawa, Ont.: Minister of Mines. Paper; 7x10 in.; pp. xxiv + 213; illustrated. 25c.

SURFACE SUBSIDENCE IN ILLINOIS—By Louis E. Young. Bulletin 17, Illinois Coal Mining Investigations. Prepared under a coöperative agreement between the Illinois State Geological Survey, the Engineering Experiment Station of the University of Illinois and the United States Bureau of Mines. Urbana, Ill.: State Geological Survey. Paper; 6x9 in.; pp. 112; 56 illustrations.

SURFACE WATER-SUPPLY OF THE UNITED STATES, 1914—By Nathan C. Grover, Chief Hydraulic Engineer. Washington, D. C.: United States Geological Survey. Paper; 6x9 in.; illustrated. Part I. North Atlantic Slope Drainage Basins—By C. C. Covert, C. H. Pierce and G. C. Stevens, District Engineers. Prepared in coöperation with the States of Maine, Vermont, Massachusetts and New York. Water-Supply Paper 381. Pp. xxxvii + 195. Part II. South Atlantic and Eastern Gulf of Mexico Basins—By Guy C. Stevens and Warren E. Hall, District Engineers. Water-Supply Paper 382. Pp. xxx + 66. Part XII. North Pacific Drainage Basins. B. Snake River Basin—By G. C. Baldwin and F. F. Henshaw, District Engineers. Prepared in coöperation with the States of Idaho, Oregon, Nevada and Washington. Water-Supply Paper 393. Pp. 248.

TABLES AND OTHER DATA FOR ENGINEERS AND BUSINESS MEN—Compiled by Charles E. Ferris, B.S., Professor of Mechanical Engineering, University of Tennessee. Knoxville, Tenn.: University Press. Twentieth edition. Leather; 3x6 in.; pp. 159. 50c.

TESTS ON CORRUGATED METAL CULVERTS—Orono, Maine: University of Maine. Technology Experiment Station Bulletin. Paper; 6x9 in.; pp. 15; illustrated.

Gives the comparative results of an investigation of several corrugated metal culverts.

UNITED STATES GOVERNMENT SPECIFICATION FOR PORTLAND CEMENT—Washington, D. C.: United States Bureau of Standards. Circular No. 33, third edition. Paper; 7x10 in.; pp. 43; illustrated. 10c. a copy from the Superintendent of Documents.

"This specification," the circular states, "is the result of several years' work of a Joint Conference representing the United States Government, the American Society of Civil Engineers and the American Society for Testing Materials. It was adopted by the United States Government and by the American Society for Testing Materials, to become effective Jan. 1, 1917."

UNITED STATES RECLAMATION SERVICE: Report for 1915-16—Washington, D. C. Paper; 6x9 in.; pp. 806. 75c. in cloth or 50c. in paper.

VALUATION, DEPRECIATION AND THE RATE-BASE—By Carl Ewald Grunsky, Eng. D., M. Am. Soc. C. E.; assisted by Carl Ewald Grunsky, Jr., E. M., M. Am. Inst. Min. E. New York: John Wiley & Sons, Inc. Cloth; 6x9 in.; pp. viii + 387; illustrated. $4.

THE WEST VIRGINIA FLOOD OF AUG. 9, 1916, AND THE HEALTH RELIEF MEASURES—By Mayo Tolman, Director and Chief Engineer, Division of Sanitary Engineering, State Department of Health, Charleston, W. Va. Reprinted from American Journal of Public Health (Boston, Mass.), Vol. 6, No. 10. Paper; 7x10 in.; pp. 1083-1086; illustrated.

Notes from Field and Office

Night work may be economical—Portable steel buildings easily erected—The army truck on the Mexican border—Cement mortar repairs to stonework—Jacketing wood piles

Night Work Frequently Is Economical

By J. L. Harrison*

The comments in regard to the efficiency of night work, in *Engineering News*, Aug. 17, 1916, and the notes by Hunter McDonald in the issue of Oct. 26, 1916, together with some observations of my own, lead me to think that the ramifications of this question have not been very fully thought out by the average contractor. Roughly speaking, contracting costs may be divided among (1) materials, (2) labor and its superintendence and (3) plant. Now it will not be seriously contended that items falling in the first classification are modified appreciably by working at night. Items in classification (2) may be, in fact usually are, modified unfavorably by night work as ordinarily carried on. Here the average contractor usually closes his analysis of the situation and asserts the increased cost of night work. However, if he would analyze the third classification—his plant cost—he would often find a gain that would more than offset any necessary labor loss.

Years ago the writer worked for a time in the East Pittsburgh plant of the Westinghouse Electric and Manufacturing Co. Even then this plant was enormous, but it lay absolutely idle during more than half of each working day. Had the plant been only half as large and worked two shifts instead of one, the labor cost would have been about the same, but the plant charges would have been cut about in two, to the great advantage of the company. A vivid idea of what this may mean in dollars and cents can be had by analyzing the annual report of any large industrial company.

It is pretty generally admitted that machinery and equipment usually become functionally obsolete before they are worn out. In other words, old machines are scrapped because new ones can be secured to do their work better and cheaper, rather than because the old ones are actually worn out. Depreciation is not, therefore, as accurately expressed as a function of the number of hours work done by a machine as it is as a function of human progress; and it is consequently possible to reason that, if one man gets two hours of work out of a machine where his neighbor gets only one, he has obtained a large advantage. The phenomenal success of the Ford factory is, in no small degree, based on this principle. Usually, people talk of the "low capitalization" of this unique plant. This low capitalization is of course a reality, but its interest for the contractor lies in the fact that there is probably no other plant in the world where the full capacity of the equipment used is so nearly reached as at the Ford plant.

Now to come back to the question of night work, it is both more easy to maintain a high labor efficiency in night factory work and to see the lower plant costs per unit of work done on two- or three-shift work, when factory conditions are considered than when ordinary contract work is examined. Yet the same general conditions prevail. In the first place, successful night work depends absolutely on adequate light. This is not so much dependent on the quantity of light as on its proper distribution. A few large lighting units may throw more light than a good many small units; but if they are so placed that they throw heavy shadows, the work done under them is almost sure to be inefficient.

In the next place, night work must be kept up so long that the laborers get used to it. This is very important. In fact, the impression that night work is expensive is largely due to the high costs that have been obtained during abortive experiments with it.

Another point of considerable importance is the fact that, for some reason, contractors usually put their best superintendents on the day shift and their second-rate men on the night shift. This has an adverse effect on efficiency in general and results in unfair conclusions as to labor costs.

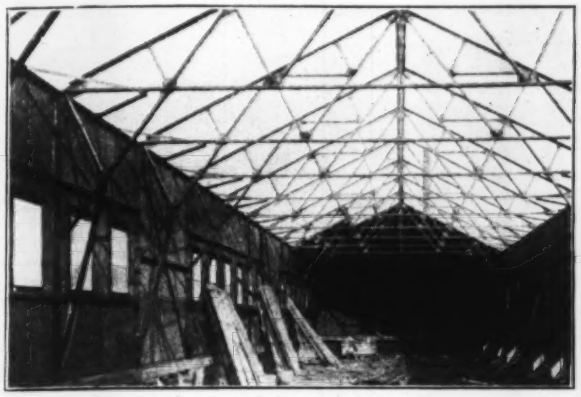
When the excessive temperature of the daylight hours during the summer months is considered, it seems remarkable that more effort has not been made to develop the possibilities of night work. The writer can find no adequate reason for it, either in factory production or on contract work, unless it be the natural preference of all normal human beings for daylight work. However, plant and equipment are becoming a larger and larger percentage of the unit costs of the finished product, in both factory and field production, and unit costs can be reduced in no other way so easily as by making the rate of actual useful wear on the plant at least keep up with the rate of functional depreciation. At present this can be done only by working two or more shifts.

Not so long ago railroads of America ran only during the daylight hours. But where is the railroad in America today that could stop running at night and pay dividends? The increased capital cost that would be required to handle the present railroad business between sunrise and sunset would be tremendous. In the Philippine Islands an English concern has been running a railroad on the daylight plan. Its president told the writer not long ago that he guessed the road would have to be double-tracked before it could pay dividends! We smile over such antediluvian ideas—yet many of our American factories and most of our contractors are planning to double-track their plants rather than *double-shift* their present equipment. The railroads have stood up nicely under the "lower labor efficiency" of night work, and so has the Ford plant. And so could every contractor who has more work than equipment, if he would give the matter his careful attention.

*Civil Engineer, Bureau of Public Works, Iloilo, P. I.

Erecting a Portable Steel Building

Buildings of sectional construction, as shown in the accompanying view, are being used for structures of various sizes and purposes. The steel frames support the roof trusses, and between them are fitted side sections or panels 8 ft. long and 8 to 18 ft. high. The panels may be solid or filled with windows. The ends, doors and



SECTIONAL STEEL BUILDING

other parts are made in the same way. The framing is of heavy steel angles, and corrugated painted sheets are used for the sides and roof. Kneebraces connect the trusses and side posts, and horizontal braces stiffen the corners. Diagonal bracing is fitted in some of the side panels. For foundries, etc., a monitor roof is added to provide ventilation. The parts are put together with bolts and clips, the only tools required being hammers, drift pins and wrenches.

This construction is being employed for both temporary (or portable) and permanent buildings for railway and manufacturing purposes, such as section and toolhouses, machine shops and car-repair shops, and especially for pumphouses, power houses, etc., in the oil fields and oil refineries. The view shows a shop building 24 ft. wide, with the trusses braced between the side posts. These sectional buildings are manufactured by the Steel Fabricating Co., of Chicago, Ill.

Lessons from the Army Motor Trucks on the Mexican Border

By C. F. Harrington*

The very extensive use of motor trucks by the United States Army on the Mexican border in 1916 gives several lessons in the adaptation of power vehicles to military transportation service under trying conditions. The writer had a chance to watch the trucks and reports a couple of these lessons here—(1) on getting past bad spots in the roads, and (2) on the strain upon drivers. The trucks are driven and cared for mostly by civilian drivers, but there are a few enlisted men in this service.

Truck companies have been organized consisting of about 60 trucks each, with one driver to a truck, and they are stationed at different bases. The function of these truck companies is to carry supplies to the outlying bodies of men, and in some cases to carry the men themselves. The system under which these trucks are handled is very complete, and in Mexico they make their trips with almost railroad regularity. The men make two or three trips into Mexico, take a day to go over their engine, and then they have a day or two to themselves.

The trucks used are of different makes and include rear-wheel chain-drive and four-wheel-drive equipment. This last-named type of truck is powerful and can carry a very heavy load over rough country, but without any load it seems too light for towing. This may be shown by citing one instance. There was about a mile of road under construction at one point between El Paso, Tex., and Las Cruces, N. M., and here the trucks were compelled to turn off into the sand. They had to plow through soft sand and adobe dirt sometimes hub deep; in wet weather they had slippery places and heavy adobe mud to contend with. A good many of the trucks were stuck here every time they passed through, and other trucks were called upon to pull them out. To my observation the rear-wheel-drive trucks proved more successful in such emergencies. The four-wheel-drive truck seemed too light to utilize the power it had. It would appear that each company might well have a heavy tractor to tow the trucks past bad spots—saving time and wear on equipment.

The road maintenance is a big problem on the Mexican border. The soil, of course, is very soft and sandy, and the army engineers have made only temporary roads. With over 200 heavy trucks passing daily the roads are quickly worn out.

While the wear and tear on the trucks can be cared for at the service stations, a worse trouble is the effect of the hard riding on the men. Drivers are continually being treated for internal injuries. In one instance an army officer who had gone into Mexico in his own car (which broke down) had to ride back on a truck to Columbus. He was about 35 years old and in good physical condition. But when he reached Columbus, he had to be taken to the hospital. The comfort of the men should be looked after more in the designing of the truck than it now is. The important things in the eyes of the designer are power and capacity, and the comfort of the driver is too little thought of.

*20 Circuit St., Boston, Mass.

Cement-Mortar Repairs to Stonework

By J. S. Lindsay*

The Sedgwick County courthouse in Wichita, Kan., erected about 30 years ago, has shown rapid deterioration during the past two or three years. It was built of Sawley County (Kan.) stone, which is quite soft. Last

*County Engineer's Office, Wichita, Kan.

STONEWORK PARTIALLY FACED WITH CEMENT MORTAR

summer W. F. McCabe, a local contractor, faced and repaired with cement mortar all the steps and other worn parts of the ground floor of the building, and plans are being made for surfacing the entire building next year.

The contractor selected high-grade lumber for forms. The work done last summer was not far enough above the ground to render it impossible to brace the forms from the ground or from projections on the building. Forms, built of finished 2-in. lumber, were made up complete by the planing mill. No form marks were allowed to show.

In preparing the stonework the first operation was to clean it with a wire brush. Afterward it was thoroughly soaked by a stream of water from a hose. It was then given a neat cement wash, put on with a brush. The forms were next erected, and a 1-in. layer of 1:3 cement-sand mortar was applied quite wet, by means of a brush. Neat cement finish was given to all the work in similar manner. The top of the steps was tamped and troweled.

The mortar, which was laid on only when the work was shaded as much as possible, was immediately covered and was kept damp and cool; forms were removed after 24 hr. No difficulty was experienced in getting a bond between stone and concrete.

Sand was available costing 70c. per yd. on the work. Cement cost 40c. (at the rate of 42½c. per sack) on the work. Two men were employed, one receiving $3 per day; his helper was paid $1.75. These two placed 8 sq.yd. per day. Exclusive of form costs, it is calculated that the work was done for about 80 to 90c. per sq.yd. The cost will be considerably increased as soon as the work is carried farther above the ground.

Ohio County Paving Job Presents Some Unusual Construction Features

The asphalt paving of Euclid Ave. through East Cleveland, Ohio, during the season of 1916, involved some unusual construction features. The work was in two parts and was done by two contractors employing different types of the same asphalt plant. The length of the work was 2.64 mi.

The street is 86 ft. wide between building lines and 54 ft. between curbs, with a central strip of 19 ft. occupied

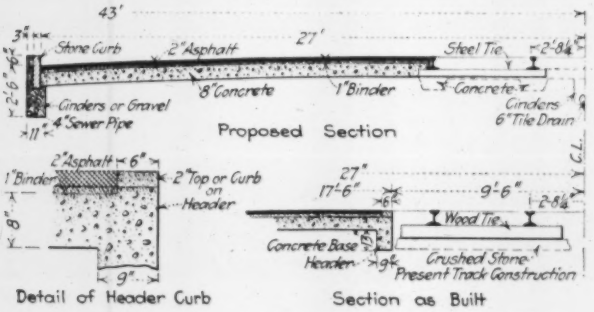


FIG. 1. METHOD OF PAVING OUTSIDE THE CAR TRACKS, EAST CLEVELAND

by the street-railway tracks. The refusal of the street-railway company to relay its tracks to conform to the new grade of the street made special construction necessary.

The paving consists of an 8-in. concrete base, a 1-in. asphaltic close binder course and a 2-in. top course of sheet asphalt with portland-cement filler. The concrete is a 1:2½:5 mix, with coarse aggregate of ¼ in. to 2½ in. The curbs are of Berea stone, 5x20 in., set on a bed of cinders or gravel in which a 4-in. tile drain is laid.

Instead of extending the concrete base to the tracks, as in the original design, it was extended only 17½ ft. from each curb (or to within about 2 ft. of the nearest rail) and ended in a 9-in. header or supporting wall 13 in. deep below the subgrade. On the edge of this was built

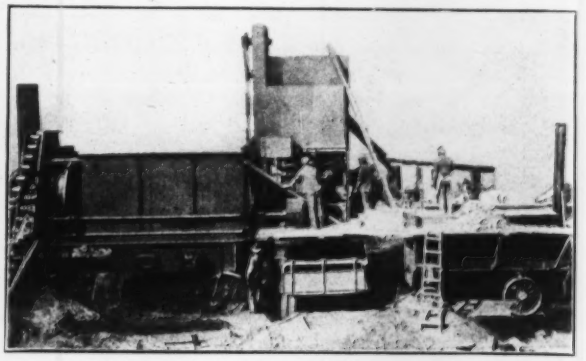


FIG. 2. PORTABLE ASPHALT PLANT WITH MOTOR TRUCKS FOR DISTRIBUTING THE MATERIAL

a concrete curb 6 in. wide and 3 in. high, its top being flush with the surface of the asphalt. The top finish of this curb, to a depth of 2 in., was made with a 1:1:2 mix, in which crushed granite was used as the coarse aggregate. It is anticipated that this part of the curb will be cut off flush with the base when the pavement is extended to the car tracks.

The track space between these headers is paved temporarily with brick, having a mastic filler. On each side this brick paving is sloped from the uniform grade of the header curb to the varying level of the heads of the outer rails, which is as much as 8 in. above and below the street grade. This makes an unsightly appearance.

On account of the narrow width of the paved driveway, 17½ ft., and the impossibility of working across the full width of the street, neither of the contractors was able to roll the surface transversely. The necessity of interrupting the work at cross-streets, in order to maintain some of the latter open for traffic, also hindered systematic progress.

The western half of the work, 1.29 mi., was done by the Cleveland Trinidad Paving Co. This company used Bermudez Lake asphalt and prepared it in a Cummer stationary plant equipped with a drier heated by oil fuel. The material was distributed on the street by motor trucks, the haul being from 5 to 7 mi. The company's asphalt-surfacing force was composed as follows: One foreman, two roller men, four rakers, two tampers, one smoother, two dumpers, six shovelers and two laborers. On account of traffic conditions it was impracticable to complete the surfacing at one move, but this gang had to move to different parts of the work at five different times, which added to the expense. Nevertheless, with 8-hr. shifts this company averaged 3600 sq.yd. of 1-in. close binder and 1800 sq.yd. of 2-in. surface per day.

The eastern half of the work was done by Pace Brothers, of Cleveland, who used Aztec asphalt. Their material, which was prepared in a Cummer portable plant of 1800 yd. capacity, installed about a mile from the

center of the work, was distributed by motor trucks. With this plant the average output per 8-hr. day was 3000 sq.yd. of binder and 1500 sq.yd. of top surfacing, while the maximum outputs were 3550 and 1750 sq.yd. respectively. This plant had a new type of sand drier that proved successful in handling fine and wet sand. Fig. 2 is a view of the plant.

Each contractor used a Foote mixer for the concrete, and each had two rollers for finishing the asphalt surface. The concrete mixer employed by Pace Brothers was equipped with a Jones distributor, which is said to have greatly improved the character of the work, while at the same time it reduced the labor of shaping the foundation.

The work was done under the direction of D. Moomaw, County Road Engineer, Cleveland, Ohio.

Special Forms for Jacketing Wood Piles with Concrete

A system of wood-pile protection from marine borers by the use of concrete casing has been devised by A. Neubert, a master diver of Oakland, Calif. The system of unit concrete forms for incasing piles above and below water, upon which the method of protection depends, has been patented by Mr. Neubert.

These forms are made in units of stock-size lumber. Standard machine bolts are used for attaching the cross-

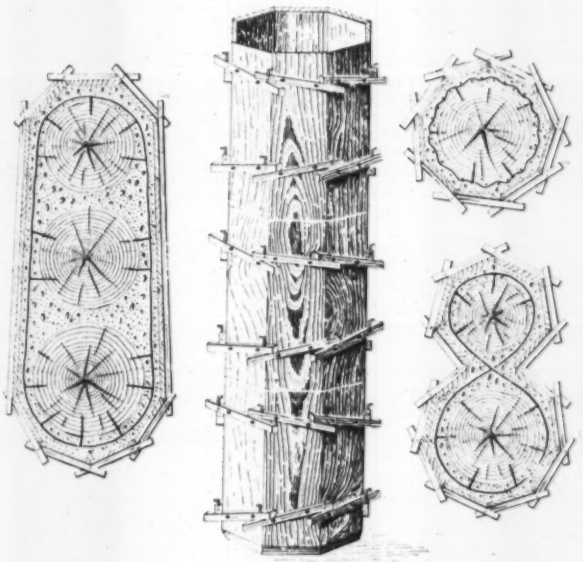


FIG. 1. NEUPERT SYSTEM OF ENCASING WOOD PILES IN CONCRETE SHELLS

pieces to the side members, as shown in Fig. 1, and 80d. nails bent over at the top serve to connect the units together as pins through the crosspieces. The edges of the side-form units are beveled and are drawn together by twisting the pins, which work eccentrically in the holes in the crosspieces. These crosspieces or hoops are placed every vertical foot. The completed forms are hexagonal or octagonal in cross-section and can be erected at any angle in order to inclose batter piles.

The equipment for a single concreting gang consists of 120 lin.ft. of forms, which is enough to allow the concrete to set for 24 hr. Three flatboats capable of carrying 1½ cu.yd. each of concrete aggregate, a scow for water, with a deck for use as a concrete-mixing platform, two rafts for carrying the forms, and one small flat-bottomed rowboat complete the equipment. The working force consists of a foreman, two men to place concrete and erect the forms, and four men to mix and pour the concrete. This outfit, it is claimed, will place on an average of 40 lin.ft. of concrete-pile casing per day. The work can be organized into any number of gangs of this size.

The accompanying illustration, Fig. 2, shows the pile-trestle approach of the Coos Bay bridge of the Willamette

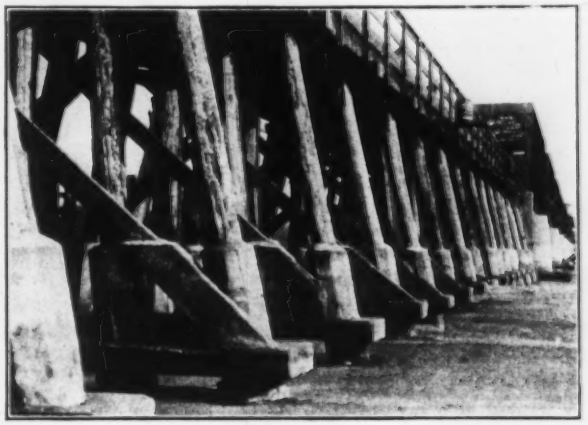


FIG. 2. WILLAMETTE PACIFIC R.R. BRIDGE OVER COOS BAY, OREGON

Pacific R.R., protected by the Neubert system. The underwater sections were placed by a diver. These forms gave an octagonal shell of concrete 8 in. thick around each pile. A reinforcement of wire mesh was also used, placed near the outside of the shell of concrete. This wire netting was held in place by nails and spikes driven into the piles. The pile casings of the three or four bents nearest the bridge average 37 ft. in length. Cross-braces and diagonal braces up to 6 ft. above tide level were included in the concrete casing, using the same system of forms.

Comparison of Horse and Motor-Truck Hauling in Pennsylvania

By G. F. Alderson*

There has been an excellent chance during a year past to compare team and motor-truck haulage of road materials in the service of Longwood, Inc., of Kennett Square, Penn., a concern operating a 500-acre estate in Chester County. The cost per ton-mile has been 23.8c. for teams and 16.5c. for trucks.

In addition to the construction work about a large estate, the corporation repairs and maintains 10 mi. of macadam roads and from time to time constructs new sections. William M. Francis, of Wilmington, Del., is superintendent, and the writer, acting in a subordinate capacity, comes in direct contact with the details of the work. The subject matter herein is the result of his own personal observation and collection of data.

Considerable quantities of crushed stone and screenings have to be handled in the course of a year, so that

*Kennett Square, Penn.

economical haulage is important. A 2¼-ton standard chassis (Autocar) was bought and fitted with a special body with a power dump and driver's cab. The outfit cost $2100. Both truck and teams have been used in hauling the same materials.

Daily record sheets give an exact account of the truck's operations. Each day the driver turns in a sheet properly filled out. A hubmeter records the daily mileage. A typical sheet shows the following items:

Date	Nov. 17, 1916
Miles traveled	77
Number loads hauled	11
Material hauled	Crushed stone
Gasoline used, gal	10½
Cylinder oil used, pints	5
Distribution of time	5 hr., job 54-d; 5 hr., job 18-E-1
Remarks	11 loads of stone hauled from bins at Mendenhall
Driver	Bevan

The truck ran 12,000 mi. the first year. During that time the repair bill was very small; there were only minor breakdowns, making this item $20. For depreciation, 25% of the first cost was allowed; this, of course, was only an estimate that, at the end of the year, seemed to be ample. The fixed charges and cost of repairs on the truck for the entire year were as follows:

Depreciation	$525 00
Interest, at 4%	84 00
Repairs	20 00
Insurance	25 00
Total	$654 00
Total per mile	0 055

The following data were obtained from an average of the record sheets for the whole year:

Average daily mileage	66 20
Average daily consumption of gasoline, gal	10 75
Average miles per gallon of gasoline	6 16
Average daily consumption of oil, gal	0 66
Average miles per gallon of oil	102 00
Average length of haul, miles	2 85
Average number of loads per day	8 62
Average number of tons per day	19 40
Average number of ton-miles per day	55 30
Cost of Operating Truck One Day:	
Repairs and fixed charges ($0 055 × 66 2)	$3 64
Driver	3 00
Gasoline (10½ gal. at 20c.)	2 15
Oil (¾ gal. at 45c.)	30
Total	$9 09
Cost per ton-mile	0 165

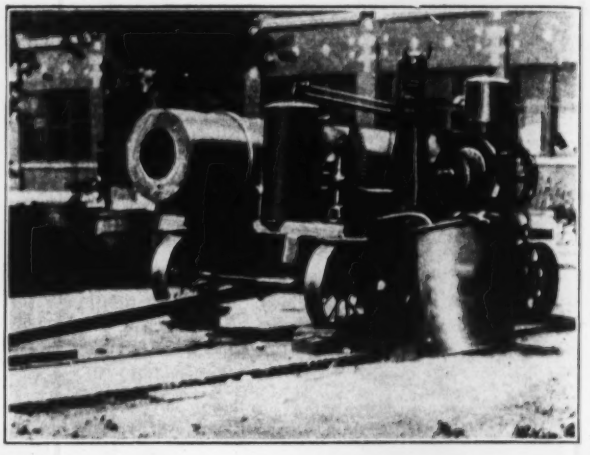
The teams that were used for hauling similar material were hired at $5 per 10-hr. day. This amount included the driver's wages. The teams were closely observed, and it was determined that the best results were obtained when a load of about 3500 lb. was hauled. A team doing a good day's work hauls four such loads a distance of 3 mi. in 10 hr., or the team is credited with 21 ton-miles per day. Hence, at 50c. per hr., the cost per ton-mile to haul the same material by teams amounts to 23.8c.

As is evident from the foregoing figures, it is 73c. cheaper per ton-mile to haul with the truck than it is to haul with teams. Last year the truck hauled a little over 13,500 ton-miles; or the total saved by the use of the truck was $985.50, which is almost half the cost of a new truck.

The low cost of operation of the truck per ton-mile and its decided economy over team hire for this kind of work seem to be due in large part to the fact that it is exactly suited to its work. On the long hauls, because of its speed, it outdistances the teams. Its greatest radius of operation per 10-hr. day is 33 mi., whereas the team can never get more than 12 mi. from home. The automatic dumping and quick return to the storage bins or cars make the truck especially desirable for the shorter hauls.

FINE AGGREGATE

The Cost of Tar Filler for a brick pavement on Ionia Ave., Grand Rapids, Mich., is given in the accompanying table. The tar used was the Barrett Manufacturing Co.'s special coal-tar paving pitch, having a specific gravity of 1.29 and a melting point of 120° F. This was heated in kettles to about 275°. It was mixed with sand (60% of which passed a 30-mesh screen) that had been heated by means of a Rapid Mixer Co.'s special sand-drying machine to a temperature of about 350° F. One bucketful of hot tar and one bucketful of hot sand were placed in an ordinary wheelbarrow and thoroughly mixed by means of hoes. The mixture was poured from the wheelbarrows on the brick pavement and was quickly worked into the joints by the use of squeegees. The joints were filled to the top, and a thin coat was left on the surface of the brick. The surface was then covered with a very light coat of torpedo sand and the street opened for traffic. The pavement was laid by the Carpenter Construction Co., of Grand Rapids, Mich. The bid for Metropolitan paving brick, including 1½-in. sand cushion and tar filler, was $1.40 per sq.yd. Mr. Carpenter furnished the following figures relative to the cost of the filler:



SPECIAL SAND-DRYING MACHINE USED TO HEAT SAND TO 350° BEFORE MIXING WITH PITCH

Cost of paving pitch	$345 35
Cost of unloading pitch	17 00
Cost of sand (20 loads at $1.50)	30 00
Cost of kerosene (for sand-drying machine)	40 00
Rent for sand-drying machine	50 00
Cost of labor	335 00
Cost of wood and coal	9 00
Total cost	$826 35
Total square yards of pavement	$5,003 00
Average cost per square yard	0 165

The average cost per square yard could be reduced to about 15c. with sufficient kettle capacity. The men on this particular job spent considerable time waiting for the tar to heat.

A Cheap Machine for Cutting "Warrenite" Pavement was recently described by M. E. Starks, of Bridgeport, Conn., Track Superintendent of the Connecticut Co., before a meeting of the local company section of the American Electric Railway Association, as reported in the January issue of "Aëra," the association organ. The machine was devised by Mr. Starks and W. F. McCoy, master mechanic, and cost about $125. It consisted of a 20-in. cutter wheel carried in a heavy iron frame hinged to the side of a single-truck trail car and accommodating itself to inequalities of the paving to be cut. The device could be attached or detached in 10 min. The frame was loaded by running a truck, carrying 2 tons of old axles, off the trailer and upon the cutter frame. The company had 16,000 ft. of "Warrenite" paving to be cut back 2 ft. from the rails so as to allow repair of the track. It was only necessary to run the cutter up and down the street a few times. A crane car with one motorman and three or four laborers would cut a 3000- or 4000-ft. strip in one night after the last car had passed. This was more than 25 men could do in 10 hr. with picks and chisels, and a better job resulted.

Editorials

Good Writing and Good Engineering

Well-put English occurs in engineering reports oftener than some people think. It is a pleasure to put on record a pleasing example of this, which at the same time drives home a lesson in good engineering that needs to be learned by citizens, taxpayers, officials and perhaps some members of the engineering profession in every city having waterways subject to encroachment by the uncontrolled results of urban growth. We quote from the transmittal letter of W. W. Horner, Engineer-in-charge of the Division of Design—Sewers and Paving, St. Louis, Mo., accompanying a report on the River des Peres drainage problem, St. Louis, Mo., as follows:

> Exactly forty years ago the City of St. Louis took to itself a portion of the River des Peres Valley. The stream was then a common country brook, clear and attractive, but subject to freshets which submerged an occasional cornfield. Since that time the city has proceeded to occupy the valley and has used the stream as a dumping ground for rubbish and sewage; and because the stream is no longer able to purify itself, it is loked upon with aversion.
>
> The city has paved streets and covered the absorbent soil with roofs until the runoff of the freshet has greatly increased. It has filled up the banks of the stream and narrowed its bed and has placed valuable improvements and traffic ways in the old cornfields; and when the stream, attempting to carry off the increased burden under these handicaps placed upon it, floods more than before, the city is aghast and horrified.
>
> The city has forced on the stream a utilitarian character, which it is unable to assume, and the result is an ugly and inefficient sewer. For over 15 years the people have been clamoring for the improvement of this condition, and during the most part of that time the city's engineers have been preparing for the day when the demand would become insistent.
>
> Eleven years ago, the writer became connected with this study, and continually since then has had a part in the observations and planning. A general scheme was worked out several years ago and a certain part completed. As additional data were available, the plan has been modified and crystallized, but unofficially, and it is with great satisfaction that in response to your instructions the following report and plan is presented for formal consideration.

Such an introduction to a report creates interest and conviction at the start. It is a pleasure to note that the plan thus gracefully and forcefully submitted by Mr. Horner on Dec. 16, 1916, was soon approved by the Board of Public Service, of which E. R. Kinsey is President. The outstanding structural features of the plan were set forth in *Engineering News* of Feb. 1, 1917, p. 209.

New Emphasis on the Human Element in Engineering Work

A few weeks ago a largely attended conference was held at the Ohio State University to discuss the human element in engineering work. More recently a similar conference was held at Columbia University in New York City. Similar meetings have been conducted annually in Pennsylvania, for some years, under the direction of Dr. J. P. Jackson, head of the State Labor Bureau. These meetings at widely different points are significant of the fact that engineers and business men are taking a greater interest in the practical problems of sociology.

Most engineering students desire to fit themselves for executive positions. They understand that the large pecuniary rewards in engineering, as in all other lines of business, go to the man who has the ability to handle men rather than the man who deals solely with things. There has been a really amazing awakening among employers of labor everywhere to the necessity of dealing with labor with a degree of intelligence, tact and humanity that would have been condemned as soft-hearted foolishness a generation ago.

A criticism often made of the courses of study in the technical schools is that they give a man little or no instruction in the art of dealing with men. We have before referred to the remarkable movement in charge of the International Committee of the Young Men's Christian Association, which has been for the past few years developing in many engineering schools a plan of work whereby students in their junior and senior years may gain practical experience in dealing with the workmen with whom, later in their career, they may come in daily contact as managers.

This "Industrial Service" movement, as it has been called, has recently developed a college course for the study of the human side of engineering, covering 64 to 96 class periods, or four to eight months' work, with two or three recitations per week. The course includes such subjects as the evolution of the individual worker in industry, industrial organizations, relations of capital and labor, working conditions, living conditions, leisure conditions, ethics of engineering and business, vocational guidance, how to handle men, engineers' responsibility for service.

A course of study following these general lines seems well calculated to meet the demand that the engineering college should send out its graduates equipped with some knowledge of the foundation principles of dealing with men. Those desiring to obtain further information regarding this new college course can obtain it from the Secretary of the Industrial Service Movement, Fred H. Rindge, Jr., 124 East 38th St., New York City.

Crippling Their Own Water-Works

Making every tub stand on its own bottom is a good rule to apply in municipa' as well as other realms of human activity. There has always been a strong temptation to do otherwise in the municipal field in order to favor some weak service or to lessen the burdens of direct taxation at the expense of the patrons of some revenue-producing municipal enterprise. Water-works most often suffer by such spineless and unjust practices.

A case in point, where not one water-works but many throughout a whole state are involved, is afforded by Massachusetts. Here, according to the 1916 report of the engineering division of the Massachusetts State Board of Health, recently sent to the legislature, it is becoming common practice for municipal authorities to

use water-works surplus funds to meet the general expenses of the city. This would be bad enough if the needs of the water-works were amply provided for before drafts were made on the water-works revenues, but it is doubly or trebly bad when the income diverted to other municipal purposes is sorely needed to keep the works up to standards of quality, quantity and pressure.

Municipal authorities in Massachusetts and most if not all other states would do well to consider the fact that it is unfair to make a water consumer pay a part of the general expenses of the city when he settles for the water supplied him. The water charge should cover, and cover adequately, the cost of that service alone. Whether it does or not, few cities know, because water rates in the past have generally been fixed by guess or by blindly copying those of some other city. This is not all. Comparatively few cities really know whether their water-works are making or losing money. Unless the engineering division of the Massachusetts State Board of Health has closely looked into the matter, we should not be surprised if many of the cities that on the face of it are using water-works profits to reduce taxes are really only chasing the devil around the stump—the profits being apparent only. This, however, does not lessen the seriousness of the charge that the water-works are being crippled—so far as intent or carelessness is concerned—but it is an indication of municipal muddle.

Opportunities for Engineering Work in Foreign Fields

Those who have the largest outlook on the currents of trade industry and finance are united in the belief that unprecedented opportunities are open for the United States to undertake enterprises in foreign countries. The National City Bank, of New York, in its January *Bulletin* says:

> The opportunity to extend American trade abroad should be much better in the years following the war than during the war. We are able now to enter this field in a new capacity, that of an investor and organizer.
>
> The United States has become much the richest country in the world. Even before the war its annual gains available for investment were as great as those of any three other countries, and our preëminence in that respect is now greater. Our steel-making capacity is equal to that of all the rest of the world, and the same is true of our tool-making and machine-building capacity.
>
> There has never been a time when there was such pressing need for improved appliances for increasing production as there will be after the war. We can go out to the undeveloped countries and put into the hands of their people the means of opening new stores of wealth not only for themselves, but for the common supply.
>
> We have come into a position of leadership, but are we going to make ourselves felt in the organization and advancement of the world? If we really set about doing this and have anything like a national appreciation of what we can do, we need have no uneasiness about business opportunities after the war. There is no limit to the opportunities in Latin America, China, Russia and elsewhere. We are passing through times when ability, competency, readiness and willingness to render service beyond our borders count as never before and will be compensated as never before.

In this connection notice the curves of average yearly compensation of engineers, based on geographical groupings, compiled by the American Society of Civil Engineers Committee and published on page 41 of our issue of Jan. 4. That diagram showed that the average compensation of engineers engaged in work in foreign countries is far higher than the average compensation of engineers employed in any part of the United States. To a certain extent this rate of compensation for the engineer sent abroad must be discounted on account of the additional cost of living, the traveling expenses, etc., which the American engineer working in foreign countries necessarily has to incur.

In considering the opportunities for engineers abroad, however, it should be clearly understood that there, as well as here, the chief profits will go to the men who have the energy and the ability to undertake successfully the work of promotion and organization; and the engineer who merely performs on a salary the technical work of design and construction will be hired at as low a figure as his services will command in the market. The large prizes will go to the men who can perform the difficult work of finding the promising opportunities, judging which are actually valuable and which only appear so, and then bringing together the necessary capital and technical skill to make the opportunity yield profits. If the engineer combines with his technical knowledge the ability to act as a promoter and organizer, he has at least as good a chance for these prizes as anyone.

Increasing Cost of Producing a Graduate Mining Engineer

At a recent meeting of the Mining and Metallurgical Society of America the general subject for discussion was the great increase in the cost of mining and smelting ore which has taken place during the last three years, and Professor Peele, of Columbia University, referred to the heavy increase in the cost of engineering education. The average expenditure by the School of Mines of Columbia University on the average graduate in mining engineering, which was formerly $2600 to $2700, is now $5000 to $5500. One cause of this change is the substitution for the old four-year course of a three-year course, preceded by three years of scientific college training, of six years in all. An effect of this increased length of course is to reduce the number in each class, which means a proportionate increase in the cost per student.

These figures, it should be noticed, represent the gross cost to the university. Part of this cost is paid by the student himself in tuition fees, but only a small part, as the rate of tuition is only $250 per year. The total cost to the student for his education is a much larger sum even than this, for besides his living expenses during the period of his education, the value of his time must be included, or, in other words, the amount that he would earn in some other occupation if he were not engaged in study.

It may be assumed that the average engineering student in the School of Mines could, during the six-year period of his professional studies, earn an average of $800 a year. Add this $4800 to the $5500 estimated above as the total cost to the university, and it appears that a graduate in mining engineering represents a total investment, during his professional education alone, of over $12,000. In fact, the sum is considerably in excess of this, for to be strictly accurate, interest should be figured on each year's expenditures.

In these days when so much emphasis is laid on accurate cost accounting and so much is said concerning the low compensation of engineering service, it is worth while to consider what a large investment is required to produce a finished engineer graduate.

Cleveland Engineering Society Urges Commission for City Paving

The City of Cleveland is to spend nearly $10,000,000 for the improvement of its pavements. The voters have indorsed a bond issue of $3,000,000 to provide money for the city's share of the work, and it is estimated that over two-thirds of the cost will be met by assessments on private property owners. The Cleveland Engineering Society recently adopted a resolution urging the city government to place this paving work in charge of a special commission. The members of the Engineering Society in making this recommendation were doubtless familiar with the experience at Baltimore, where a similar large outlay on street paving has been in progress for some years. The Baltimore work has been directed by a commission with a capable engineer at its head, and first-class work has been secured and is shown by the newer pavements. The Cleveland city officials, however, look with no favor on this proposal by the Engineering Society. Mayor Davis is quoted as saying that the city administration is responsible for spending this money and "does not care to be relieved of its responsibility."

The citizens of Cleveland may well ask their mayor why he is so anxious to retain this responsibility. Manifestly, he cannot discharge it personally and must delegate it either to the officials of the street department, now organized only to care for maintenance work, or to a special commission, as urged by the Cleveland Engineering Society. The experience of many cities has demonstrated that the latter plan is far more likely to produce honest and economical work. There ought to be an outspoken expression of public opinion in Cleveland to back up the Cleveland Engineering Society's proposal.

Letters to the Editor

Mill Construction a Well-Defined Type

Sir—I have read with interest the articles on "The Cost of Factory Buildings, of Timber and of Concrete," by F. E. Davidson and T. L. Condron, which appeared in the issue of "Engineering News" for Nov. 9, 1916. In the Dec. 21 number of your magazine you also printed a letter from Lewis Muhlhauser, which I interpret as intended to follow up the discussion between Mr. Davidson and Mr. Condron. This impression is drawn from the heading of the article and the reference made in the first line of the first paragraph.

I believe that the wording of the title for this article was unfortunate, since the text does not in any sense bear out the title. In fact, "mill construction" seems to play no part in the building described by Mr. Muhlhauser. It states very clearly in both the first and second paragraphs that the building in question in Mr. Muhlhauser's comparison consists of steel skeleton frame with wood-joist floors. In true mill construction heavy timber is used for the interior framing and floors. The type of construction in which steel beams and steel or cast-iron columns are used in place of heavy timber members is not true mill construction and should be given a different classification.

I feel that the heading used is very likely to confuse the public at large as to the true meaning of the terms applied to the various types of construction used in our modern factory or commercial buildings. While we will all admit that timber is not suitable for use in all locations, we must agree that heavy timber construction has its proper place and definite advantages, which have been proved by long experience, both of engineers and insurance companies.

C. E. PAUL.

11 South La Salle St., Chicago, Ill., Jan. 19, 1917.

Miami Flood-Frequency Studies Based on Many Lines of Study

Sir—R. W. Davenport's criticisms of the flood forecasting of the Miami Conservancy District, published in "Engineering News" of Feb. 8, p. 248, are, on the whole, well founded and show a keen appreciation of the complexities of the problem.

In the article to which he refers[1] it was impossible to dwell on all of the phases of the Morgan Engineering Co.'s studies relating to the frequency of occurrence of great floods. For that reason a large part of the data at hand could not be discussed by "Engineering News" and this, no doubt, is the cause of erroneous impressions reflected in Mr. Davenport's letter.

Briefly stated, the main conclusions as to storm and flood frequency were derived from a careful weighing of the evidence furnished by all of the studies taken as a whole, rather than from the logical development of any one line of investigation. Indeed, a very wide range of information was utilized, the most important part of which consisted of the longest available records of rainfall and of floods obtained in many different parts of the United States. Flood records extending over many centuries on European rivers were also consulted. Many secondary studies were made which served to throw light on various phases of the subject. Some of these were described in detail in the article in "Engineering News" referred to, because they contain novel methods and are therefore of special interest to the profession. Some of these should be looked upon, however, as being byproducts that were evolved in the course of the main investigation, of value chiefly in bringing out special features, and because they help to confirm the conclusions reached by the broader method.

Mr. Davenport criticises the method of adding the storm experience of one station to that of another for the purpose of computing storm frequency over long periods, holding that the results are not applicable to areas of the size of the Miami Valley. Since the method takes no account of area, he would be perfectly correct in stating that this study in itself furnished no proof that the results are applicable to anything more than one station. But other frequency studies made by the Morgan Engineering Co., not mentioned in the article referred to, do show clearly that the results of the method criticised can be applied to areas as large as the Miami Valley with fair accuracy. It is to be regretted that the scope of the article did not permit a discussion of these other studies. Arrangements are under way by which all of the studies are to be published in order that their results may be made available to the engineering profession. This will afford an opportunity of clearing up the point raised by Mr. Davenport in a more satisfactory manner than could be attempted within the brief scope of this letter.

As regards evidence of climatic changes within the past few centuries, the studies in this field made by the Morgan Engineering Co. show that within historic times meteorological conditions have varied in many ways, but that no definite change in one direction or another can be said to be noticeable. Examinations made of the longest rainfall records in the United States, and of flood records over long periods for rivers in different localities, fail to reveal any periodic or progressive changes indicative of a climatic change. The burden of proof still seems to rest with those who advocate such theories. This view is confirmed by a recent article by H. H. Hildebrandsson in the "Monthly Weather Review" of June, 1916, entitled "On the So-Called Change in European Climate During Historic Times," from which he concludes that though climatic variations of long and short duration exist everywhere on the globe, it is not possible to prove that the climate of Europe, within historic times, has changed in any respect. Prof. J. W. Gregory states as a result of his research that "in historic times there has been no worldwide change of climate."

[1] "The Miami Valley Flood Protection Works—Fixing Maximum Flood Limits," "Engineering News," Jan. 4, 1917.

Mr. Davenport suggests that it would be instructive to compare the frequency curves[2] published in the article under discussion with similar curves based exclusively on long-time records, as a means of showing whether or not any discernible climatic change has taken place during the period covered by the longest of our existing records. For instance, a set of frequency curves which was prepared from the 22 longest existing records in the Central States Basin, the average period of record being 44.6 years, is practically identical with those referred to, which were based on the records of 478 stations in the same area with average period of record of only 15.8 years. This, though not in itself conclusive evidence that the climate is not changing, does clearly prove that if such a change is taking place it is too slow to be indicated by existing rainfall records. Noticeable cyclic changes in rainfall appear to have been indicated in certain localities within a 20-year period, but these are at variance with each other for different parts of the eastern United States, a decrease in one locality being synchronous with an increase in another locality.

GERARD H. MATTHES,
Assistant Engineer, the Miami Conservancy District.
Dayton, Ohio.

Chicago Paving Engineers Defended

Sir—The report on Chicago pavements, which was written, signed and printed in Urbana, Ill., by Prof. Ira O. Baker, of the University of Illinois, contains statements and opinions which have caused the people of Chicago to believe that the engineers of the Board of Local Improvements are corrupt, and that they have permitted paving contractors to rob the property owners of $400,000. If these statements and opinions are true, these engineers should be discharged in disgrace. If these statements and opinions are not true, Professor Baker has dishonored himself and should be denied the privilege of association with other engineers.

A portion of the alleged loss to property owners is said to be due to skimping on the percentage of bitumen in the asphalt top and binder. On page 22 of the report is a table showing the amount of bitumen in binder, and on page 28 is a table showing "actual" as compared to specified percentage of bitumen in wearing coat of asphalt pavements. It is a remarkable fact, which cannot be denied by Professor Baker, that these percentages are not based on chemical analyses, but are based upon computations made by one of the staff of investigators who had had no previous experience in asphalt paving, and who based his calculations on casual and incomplete information received from the asphalt inspectors at the asphalt plants. On pages 27 and 28 Professor Baker says:

5. Percentage of Bitumen—Data for the wearing coat like Table 1, page 22, for binder course, show that the bitumen in the wearing coat prepared by the different asphalt-paving contractors is as in Table 4, page 28. The significant thing in Table 4 is that all of the wearing coat prepared at one plant has less bitumen than the specified minimum; while all of the other plants prepare material for the wearing coat with only slightly more bitumen than the specified minimum. One would expect from the wording of the specifications that some of the plants might use asphalt, stone dust and sand of such a nature as to require more than the minimum percentage of bitumen, or that some one of them would lay asphalt on a street having travel that would require more than the minimum percentage of bitumen

TABLE 4. BITUMEN IN WEARING COAT OF ASPHALT PAVEMENTS

Firm	% Bitumen — Actual	% Bitumen — Specified
Standard Paving Co.	9.2	11 to 13.5
White Paving Co. (both plants)	11.4	11 to 13.5
Conway Paving Co.	11.6	11 to 13.5
American Paving Co.	11.7	11 to 13.5

Table 4 shows the "actual" percentage of bitumen in the asphalt from the Standard Paving Co.'s plant was 9.2%. As a matter of fact, chemical analyses of samples of asphalt from this plant taken on the same day that the investigator was there show 11.5% of bitumen. This discrepancy was due to the fact that the investigator thought that the mixture contained Trinidad asphalt, while in fact straight Mexican asphalt was being used. Based upon this erroneous calculation, which was based upon one observation, Professor Baker assumes that "all of the wearing coat prepared at one plant has less bitumen than the specified minimum."

In all of these cases (on pages 28 and 22) the amount of asphaltic cement used in each batch was understated, no allowance being made for the "over-run," which is the amount of cement that flows into the weighing bucket after the scale tips and after the valve is closed in the pipe leading from the heating kettle.

In the table on page 22 the amount of bitumen in the binder from the White Paving Co.'s plant is given as 4.9%, and Professor Baker calls attention to this as being below the requirements of the specifications. This, if correctly computed, would be at least 5.3%. In regard to this he says:

According to the specifications the bitumen should be between 5 and 8%. The most important thing shown in Table 1 is that the percentage of bitumen is in all cases very low. In one case, it is below the minimum limit of the specifications; and in the three other cases the amount of bitumen is very near the minimum limit. The average is 5.4%.

The bitumen is by far the most expensive ingredient, and any decrease in its amount means an appreciable profit to the contractor. Since it required approximately 140 lb. of binder to cover 1 sq.yd. of street, a variation of 1% in the amount of bitumen would mean a variation of 1.4 lb. per sq.yd. On a day's work, say 2000 sq.yd., this would mean a saving of 1.4 cu.yd. of bitumen, or approximately 2 tons of refined asphalt which according to present prices is worth approximately $40. Hence, by using 5% of bitumen instead of 6%, the contractor can save on binder alone approximately $40 on each day's work.

One not acquainted with the practice of laying asphalt pavements would infer from this that it was the duty of the contractor and the engineers of the Board of Local Improvements to see that at least 6% of bitumen was contained in the binder. The standard specifications of the American Society of Municipal Improvements provide for bitumen to range from 4 to 7%.

In the Chicago specifications our minimum amount, 5%, is what we consider good practice, and we usually get 5.5%. To put in more than 6% would make a soft binder that is undesirable. Professor Baker would be entitled to express a different opinion, if he did not use it to convey the idea that the paving contractors of Chicago were "saving" $40 a day on each job, and in order to do this he assumes that the "actual" amount of bitumen is even less than the computed amount.

C. D. HILL,
Engineer, Board of Local Improvements.
Chicago, Ill., Jan. 18, 1917.

The Public as an Employer

Sir—Your editorial of Dec. 21, 1916, entitled "Do Engineers Need To Eat?" raises an important question of wage theory on which the Bureau of Municipal Research of Philadelphia would like to make its position clear

After quoting from a report of the Detroit Bureau of Governmental Research on Detroit sewer construction, in which the salaries of certain engineering positions of the lower grades are criticised as too high, your editorial takes issue with the author of this report and points out that when compared with employments requiring less training and experience these engineering positions are not too liberally compensated.

As the report of the Detroit Bureau of Governmental Research sets forth, it is doubtless possible to secure young engineering graduates for less money than the City of Detroit is paying, and from the standpoint of economical management it seems proper to take advantage of this condition. The question is, Should salaries and wages be dealt with solely from the standpoint of economical management? Our answer is, emphatically, No. It is our view that the prime consideration in fixing salaries and wages ought to be the welfare of the worker. All other considerations should be subordinated to this one.

Certainly, government is an instrument of social welfare. If this is true, ought it not to be one of the prime concerns of government to look after the welfare of its own employees? Are they not as much an object of the welfare activities of government as those who are not in the public service? Since a man's salary, or his wage, is one of the most vital factors that make for his well being, the government ought to see that above all other things its employees are given adequate compensation for their services.

This does not mean that a city or state should wholly disregard present financial limitations and all other obligations in order to pay what it believes to be ideal salaries and wages; it does mean, however, that the problem should be approached from the standpoint of what is for the welfare of employees rather than from that of economical management. If necessary, let us compromise, but let us not lose sight altogether of the more important object.

FREDERICK P. GRUENBERG, Director.
Philadelphia, Penn., Jan. 26, 1917.

An International Exposition to be held at Boston in 1920 to commemorate the three-hundredth anniversary of the landing of the Pilgrims is proposed by the Pilgrim Tercentenary Commission, of which Arthur Lord, of Boston, is Chairman. The commission recommends a site for the exposition at South Boston, 1½ mi. from the State House, comprising 500 to 600 acres. The expense of creating the exposition is estimated at $15,000,000, and an estimate of about $1,900,000 additional is made for permanent memorials at Plymouth

[2]Fig. 9 on page 16 of "Engineering News," Jan. 4, 1917.

Concrete Institute Meets at Chicago

Papers of uncommon excellence, which brought forth surprisingly little discussion on the floor, were the distinctive features of this year's convention of the American Concrete Institute, held in Chicago, Feb. 8 to 10. This combination was somewhat disappointing, because the management of the society had made an unusual analysis of the program needs of a convention and had decided to eliminate certain types of papers which in previous meetings had proved dreary and dry. As a result the program, as announced, was most promising and a highly interesting discussion might have been anticipated. The papers themselves fulfilled the expectations but, as has been said, the discussions were below par, although at the same time the familiar emphasizer of the obvious was conspicuously absent. Then, too, a rigid adherence to a time schedule cut short some useful discussions which promised to unfold new experience. The attendance at the meetings, however, was greater than at any of the recent conventions.

The Institute is in a financially secure position. Through strict economy and good management it has brought its balance from the debit to the credit side of the ledger and may be expected now to increase in a healthy growth. The new President is Prof. W. K. Hatt, of Purdue University, and the Secretary is H. D. Hynds, 30 Broad St., New York City. All of the past *Proceedings* are now in print or about to be distributed and it is hoped that the *Proceedings* of the present convention will be available at a much earlier date than has been usual.

Concrete Regulations Under Discussion

The high point of the meeting was the discussion of the report of the Committee on Reinforced Concrete and Building Laws, which submitted for adoption "Standard Building Regulations for the Use of Reinforced Concrete." These regulations present in codified form the committee's long-considered opinions on the practical design and construction of reinforced concrete and are intended to be used as a guide not only to builders but to the framers of building codes. At any time in recent years such a report would have great importance as a step toward the desired uniformity in practice but just now its importance is emphasized by the recent issuance of the final report of the Joint Committee on Concrete and Reinforced Concrete. The Joint Committee's report is not a building code but it does contain the basis of a building code, the difference being only a matter of form. The Concrete Institute Committee report, on the other hand, is a building code, but in any consideration of the two reports the essential elements of design are of sufficient similarity in intent to invite a direct comparison of the two reports.

Such a comparison is necessarily too lengthy to be made here, but, in brief, it may be said that the two reports differ radically in many details of design, particularly in regard to hooped columns and to flat-slab floors, and that the Joint Committee report is by far the more conservative of the two. A typical comparison of provisions may be noted in Mr. Condron's tabulation of flat-slab coefficients noted on another page of this issue. Incidentally, for what it is worth, the information is offered that the prominent members of the Joint Committee are all of the engineer-designer class whereas the Concrete Institute's committee is enlisted from the concrete-building contracting field.

The Concrete Institute Committee report was passed to letter ballot for adoption, following a defence of the flat-slab provision by Arthur R. Lord of the committee and objections to the same provisions by Prof. A. N. Talbot, of the Joint Committee. After the passage to letter ballot, however, the attention of the meeting was directed to the fact that the Concrete Institute was represented on the Joint Committee by three members who, with some dissension on points not in controversy between the two reports, signed the Joint Committee report. In consequence the Institute is now in the anomalous position of appearing to subscribe to two reports which differ radically on most important details. After considerable parliamentary wrangle—during which the Joint Committee's report was formally "received" by the meeting and the explanation made that the several signatures of Institute members to that report neither committed the Institute to any part of the report nor the signers themselves to all of the report—the "Building Regulations" were withdrawn from the letter ballot of this year and passed over until next year. Meanwhile it is understood that the Joint Committee's report will be turned over to the Institute committee for consideration and explanation of the reasons for divergence from it.

Committee Work Outlined

Other committee work passed to letter ballot were the specifications for reinforced-concrete fence posts and the revised specifications for concrete roads, streets and alleys, which was amended in minor matters from the present standards. The Committee on Concrete Sewers presented a well-considered standard specification for monolithic concrete sewers together with recommended rules for concrete sewer design, both of which were submitted in the nature of a progress report to be printed in the *Proceedings*. Committees on Bridges, on Chimneys and Sidewalks and Floors submitted some comments on their respective subjects and Committees on Standpipes, Fireproofing and Nomenclature reported progress only.

Papers and Discussions

The most important papers of the convention might be divided into two groups—those on tests and those on concrete roads. Of the former class, three were on structural tests, one by A. R. Lord on the long-time test of a flat-slab floor panel in a building, showing surprisingly low stresses even at the end of a year of load; one by W. A. Slater on a built-up flat dome of concrete tile and one by L. J. Mensch on the Bureau of Standards test on cast-iron core concrete columns. The latter was largely descriptive and further information regarding the results must await the Government report. E. B. Smith, of the Office of Public Roads, recounted some further tests on the flow of concrete under load, but confined his paper to the experiments themselves and did not attempt to explain their practical significance. J. G. Steinle explained the field tests made by the engineers on the New York subway concrete work and S. E. Thompson outlined tests on the value of slag as concrete aggregate—tests which on the whole seemed most favorable to that material. A. T. Goldbeck, Office of Public

Roads, had two papers on tests, one to determine the friction value of different types of sub-base for concrete roads, the other to investigate the distribution of a central load over the width of a two-support slab.

The road discussions were naturally all confined to the technique and experience of concrete pavements. Reports were read on current practice as noted in New York State Highways by W. M. Acheson; on the maintenance of Connecticut highways by W. L. Ulrich; on the present condition of the Wayne County roads by A. N. Johnson; and on some of the later construction methods by W. M. Kinney. Abstracts of these papers will be presented together in an early issue of *Engineering News*. Other interesting papers which should be read in full in the *Proceedings* of the Institute are a discussion of contractors' cost accounting by Leslie H. Allen, a report of sane tests on hydrated lime as affecting concrete by Prof. H. H. Scofield, an outlined course of instruction on reinforced concrete by Prof. W. K. Hatt, and a series of papers on ornamental concrete surfaces and products.

Highway Engineers Meet at Boston

The fourteenth annual convention of the American Road Builders Association was held at Boston, Feb. 5 to 9. The Mechanics Building where the sessions were held and the exhibit of road appliances was made was admirably adapted to its uses and furnished better accommodation for the association and its exhibitors than they have ever before enjoyed. With a record-breaking attendance of over 4000, an unusually complete exhibit of road-building materials and equipment and a well-planned program, the convention was a notable success.

The technical sessions began with an outline of the "Policy and Program of the Government in Road Construction Under the New Federal-Aid Law," by Logan Waller Page, Director of the Office of Public Roads and Rural Engineering. The chief object of Federal aid, Mr. Page stated, was to assure a continuous and wise program in the expenditure of all state road funds. There has been some obscurity as to the meaning of the term, "substantial construction" in the Federal-Aid act; this, Mr. Page said, would be interpreted according to conditions and circumstances. There are instances where a sand-clay or gravel road would be considered substantial construction. In the disbursement of Federal aid the initiative must be taken by the state highway department, which must be a real state highway department and not a mere makeshift to act as agent between the Federal Government and the counties. Coöperation is to be the governing principle.

Great interest was aroused by the clause in the regulations for applying Federal aid that none would be given for payment of royalties on patented materials. This started a brisk discussion in which this ruling by the Secretary of Agriculture was both opposed and defended. A resolution was offered by L. D. Smoot, of Jacksonville, Fla., that the Association request the Secretary of Agriculture to eliminate this restriction in granting Federal aid. This was referred to the Committee on Resolutions, which at a later session made a report opposing Mr. Smoot's resolution, and after extended discussion the convention voted unanimously to support the Resolution Committee's action.

At all but one of the sessions of the congress a single paper was read on some type of road construction and all the remaining time was devoted to a general discussion of that type. This program made the sessions very interesting, and the attendance was maintained to the end.

In the session on gravel roads, the fact was brought out that patrol maintenance of this type of road in several states is proving its ability to carry a very considerable motor-vehicle traffic. Hauling gravel in winter by sled is proving economical in Maine and other northern states.

In the session devoted to bituminous roads much interest was aroused in the treatment of "bunches" and corrugation so often found on old road crusts. Attempts to smooth "bunchy" roads by the use of road machines and road planers have not been successful where the crusts are several inches thick. Instances were given where it was necessary to break up these old road crusts by hand, at heavy expense.

The paper of H. E. Breed, Deputy Highway Commissioner of New York, on concrete roads was printed in *Engineering News* of last week. Most New England engineers have done little as yet in building concrete roads and the session was crowded with those who came seeking information. Complaints of team users against bituminous roads on account of their slipperiness and the advantage of concrete roads on account of the better foothold for horses were given much prominence in the discussion.

The relative merits of delivering concrete on the subgrade by a bucket or by a chute were discussed at some length. The chute delivery was opposed because the workmen will make the concrete too wet in order to have it flow down the chute. The bucket delivery on the other hand was claimed to produce hard lumps in the road where each bucketful was dumped.

William H. Connell, in his paper on granite block pavements, said that at Philadelphia he has given up the use of pea stone or gravel in cement-grouted joints, but Worcester, Mass., according to A. T. Rhodes, Street Commissioner, still adheres to this practice with the best of results.

The paper on brick pavements by Fred R. Williams, Engineer of Paving, Cleveland, Ohio, announced that that city has been thoroughly won over to the cement-mortar and monolithic type of construction. Indeed the distinguishing feature of the discussion of brick pavement was the universal advocacy of the monolithic type of construction. If any one present believed a sand cushion was essential to good brick pavement, he did not have the courage to say so. Neither did anyone defend bituminous joints for brick pavements.

The contractors present were given an opportunity to discuss plant and equipment, the initiative being taken by John H. Gordon, a contractor of Albany, N. Y., in a paper on "The Excavation, Manipulation and Transportation of Materials." The most interesting feature in this discussion was the fact that team hauling is still in high favor with many contractors. Motor trucks of 3½ tons capacity were claimed by some to be more efficient than larger vehicles.

The last paper on the program was on the "Traffic Census," by Daniel B. Goodsell, New York City. This paper gave ample evidence that traffic censuses have been made practical use of in New York City, particularly in

TABLE SHOWING COMPARISON OF DESIGNING REQUIREMENTS FOR FLAT-SLAB FLOOR CONSTRUCTION

		* Coef.	Total — %	Total + %	Total Sum	Col. Head Section — %	Mid. Sec. — %	Out. Sec. + %	Inner Sec. + %	Total Sum	
Joint Committee	Drop	.107	62.5	37.5	100	50.0	12.5	28.1 to 22.5	9.4 to 15.0	100	
	No Drop	.107	62.5	37.5	100	50.0 to 40.6	12.5 to 21.9	28.1 to 20.6	9.4 to 16.9	100	
Concrete Institute	Drop	.090	70.0 to 60.0	30.0 to 40.0	100	60.0 to 50.0	10.0 to 20.0	18.0 to 28.0	12.0 to 22.0	100	Not over 100
	No Drop	.090	70.0 to 50.0	30.0 to 50.0	100	60.0 to 40.0	10.0 to 30.0	18.0 to 38.0	12.0 to 32.0	100	Not over 100
Chicago Ruling	4-Way	.087	66.7	33.3	100	53.2	13.4	20.0	13.4	100	Based on Head = 0.2251
	2-Way	.093	62.5	37.5	100	50.0	12.5	25.0	12.5	100	
Akme Standards 2-way	Drop	.096	60.0	40.0	100	47.0	13.0	27.0	13.0	100	
	No Drop	.099	57.5	42.5	100	45.0	12.5	30.0	12.5	100	

* Equivalent coefficient "a" in the expression Total Moment = $awl(l - \frac{2}{3}c)^2$ when c = diameter of round head.

securing legislation for street widening and in traffic regulation. The discussion was largely confined to the injury done various types of pavement by the traffic of the constantly increasing heavy motor trucks.

A resolution expressing the patriotic sentiment of the members in the present international crisis was adopted by unanimous vote and was telegraphed to the President of the United States.

Comparison of Flat-Slab Coefficients Under Different Rulings

The table at the top of this page shows a comparison of the recommendations of the Joint Committee basis for designing flat-slab floor construction, with the proposed Standard Building Regulations of the American Concrete Institute, the ruling of the Chicago Building Department and the "Akme Design Standards" of the Condron Co., of Chicago.

This table was presented in a discussion by T. L. Condron at the recent convention of the American Concrete Institute.

Pipe-Joint Welding Specifications

Some two years ago there was laid for the waterworks of Schenectady, N. Y., about 10,200 ft. of 36-in. lock-bar steel pipe. On being tested after a long delay for the completion of a reservoir, it was found that most of the leaks in the pipe line, which has never been put in use, were in the riveted circumferential joints. As calking did not make these joints tight the city decided to have the circumferential joints welded. Bids for this purpose were received on Feb. 14 by the Board of Contract and Supply, F. J. Bates, Secretary.

The pipe was made from $\frac{5}{16}$-in. and $\frac{3}{8}$-in. plates and there are 137 joints to be welded in the former and 244 in the latter thickness of metal, all single-riveted lap joints. The pipe has an average cover of 3½ ft.

The specifications provide that the welding may be done either by the oxyacetylene or the electrical process, but in either case permanent bottle-tight joints must be secured. All preparatory cleaning, scraping, chipping or other work must be done by the contractor before welding. Separate bids were requested for joint-hole excavations and for joint-hole filling, backfilling, and also for inside and for outside welding by each of the processes named, these bids to be made separately for pipe of each of the thicknesses specified. The city reserves the right to award the contracts for either process of welding and for either inside or outside welding, except that there are a few joints under pavements and also at highways crossings that must be welded on the inside. The city also reserves the right to eliminate the welding of joints on the $\frac{5}{16}$-in. plate if, after the first test, it appears to the engineer that such welding is not necessary.

The joints in the $\frac{5}{16}$-in. metal were made with forty-eight ¾-in. rivets, $1\frac{5}{16}$ in. from the edge with 4½-in. lap. The joints in the ⅜-in. metal were made with forty-four ⅞-in. rivets, $1\frac{7}{16}$ in. from the edge, with a lap of 4⅞ in. The pipe was dipped in pioneer coating in the shop and circumferential joints were recoated in the field with a similar coating.

The working pressure to which the pipe line will be subjected is about 150 lb. in the lower and 100 lb. in the upper section. The contractor must recoat joints inside and outside immediately after they are welded unless otherwise arranged between him and the engineer.

The specification requirements as to testing after the welding job has been completed are as follows:

> When all joints to be welded have been welded, the main shall be put into regular service, and if, after 30 days, all welded joints and rivets are bottle-tight and no cracks or other defects caused by the welding process have appeared to cause leaks at any other point on the pipe, the work shall be accepted by the Commissioner, subject to the maintenance provisions hereinafter set forth.
>
> In case of dispute as to the tightness, the engineer may require the main to be tested under a pressure of 200 lb. in the lower section and approximately 150 lb. in the higher section. Under these pressures all visible leaks shall be welded to the satisfaction of the engineer and the total leakage from any section shall not exceed 1½ gal. per lin.ft. of pipe. The leakage from cast-iron pipe tested with steel pipe shall be assumed as 2 gal. per 24 hr. per ft. of lead joint reckoned on nominal diameter of pipe.
>
> These tests shall be applied by the city in the presence of the contractor or his representative, and no claim shall be made by the contractor that his work has been damaged by alleged improper tests.

That the city desires to have the job rushed through is shown by the fact that the specifications require the work to be started a week after the award of the contract and completed on or before May 15, 1917.

The contractor is required to maintain all joints and rivets and any other welding or repairing done by him for a period of one year after the work has been accepted by the commission. The city will retain 30% of the contract price until after the work has been accepted. The contractor must put up a guarantee bond for the fulfillment of the one-year guarantee clause, this bond to be an amount equal to 25% of the cost of the work under the contract.

E. Otis Hunt is Commissioner of Public Works and W. Thomas Wooley is City Engineer.

250-Ft. Concrete Arch Across Spokane River Collapses During Construction

On Feb. 6, 1917, the Post St. bridge, crossing the Spokane River at Spokane, Wash., collapsed without warning while concrete was being placed on one of the arch ribs. Three of the workmen who were carried down in the fall were killed instantly and several others were quite seriously injured. The bridge was to have been a reinforced-concrete twin-rib arch of 250-ft. span and 33-ft. rise. The crown section of the arches was 6x6 ft. and the haunch section 6x8 ft., the spacing of the ribs being 20 ft. c. to c. The twin arches were being erected on framed timber falsework, footing on timber pile bents driven presumably to rock in the river bottom. The concrete was being poured in transverse units with sectional openings between and at the time of collapse the ribs were completed with the exception of one opening on one side of both ribs and the crown key section which was to have been poured last. High water conditions prevailed in the river.

The bridge is midway between, and only 30 to 50 ft. from, the Great Northern Ry. steel bridge and the Washington Water Power Co. steel bridge. It is also near the Monroe St. concrete bridge, the 281-ft. arch in which was for some time the longest in the world.

The bridge and falsework were designed by P. F. Kennedy, Engineer for Olsen & Johnson, the contractors. The erection of the falsework, together with the pouring of the ribs, was in direct charge of Mr. Kennedy until Jan. 31, one week before the collapse, when he either fell or was knocked off the service bridge and was drowned. The general supervision of the work was under the direction of Morton McCartney, City Engineer, and his assistant, B. J. Garnett. Before his connection with the contractor on this bridge Mr. Kennedy had been an Assistant Engineer in the City Engineers' office.

Mr. Kennedy seems to have had exclusive knowledge of the design and construction of the falsework, so that it is difficult to get any information regarding its condition. An analysis of the situation, however, has been made for *Engineering News* by a local engineer, but did not reach New York in time for publication in this issue. A complete description of the failure and of the falsework will therefore appear in next week's issue of this journal.

The two views herewith were taken immediately after the collapse of the structure and show the conditions at each end of the bridge.

FIG. 1. POST ST. COLLAPSE AT EAST ABUTMENT

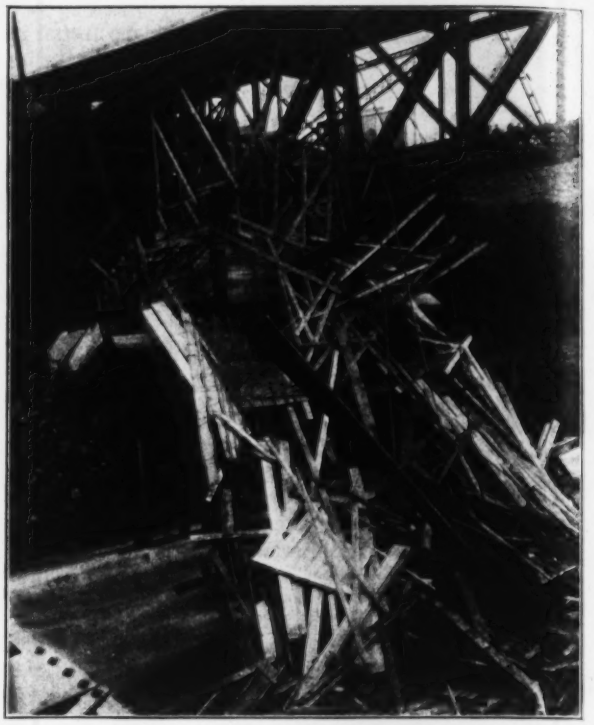


FIG. 2. LOOKING TOWARD WEST END OF THE FALLEN POST ST. BRIDGE

ENGINEERING SCHOOLS

Massachusetts Institute of Technology

Massachusetts Institute of Technology has arranged a series of lectures and experimental demonstrations in physics, chemistry and applied science for high-school pupils in and near Boston, utilizing the laboratory equipment of various departments. These lectures will be given in the large auditorium at Cambridge on certain afternoons at 4 o'clock. This work will be done through the institute's "Society of Arts," an organization provided for in the institute's charter and which for over 50 years has offered public lectures in popular science.

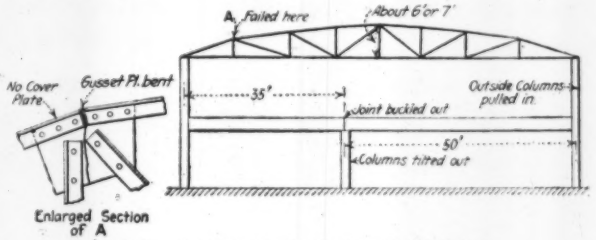
Columbia University

Because of the growth of research work in Columbia University, a plan for the organization of an administrative Board of Research has been placed before the trustees by President N. M. Butler. This board would be separate from the University Council, but responsible to it: its function would be (1) to secure suggestions from departments and individuals for specific researches, (2) to fix the order of precedence in apportionment of available funds, (3) to eliminate duplication of efforts in separate but related departments.

News of the Engineering World

Roof Truss Buckles After Erection When Not Yet Stayed Laterally

A roof truss failed by lateral buckling, Jan. 29, 1917, on the Hyatt-Buick Building under construction in Kansas City, Mo. The building, about 85x130 ft., was two stories high, the second floor being supported on plate girders extending across the building, resting on the outside steel wall columns and on an interior row of columns about 35 ft. from one side. Over the second story were steel roof trusses spanning 85 ft., supported on columns in the outside walls. All the columns and plate girders had been set but no floorbeams were in place. Two roof



DETAILS OF FAILED ROOF TRUSS

trusses had been set, bolted to the columns, and some of the 10-in. channel purlins of the roof had just been placed. These constituted the only lateral bracing in place.

During the noon hour, when no work was being done, the end truss failed by the buckling of the hip gusset-plate (see sketch), followed by the bending of the lower chord angles. This pulled the two outside columns in, forced a kink in the second floor girders, tilted the intermediate first-story columns, and pulled the second truss down. No one was injured and the damage is not great.

The trusses were very lightly built and had no cover plate over the hip joint to give lateral stiffness beyond that furnished by the vertical gusset plate.

Helping Contractors Bid on Road Construction Near Chicago

In preparing to let contracts for 60 mi. of country roads in Cook County, Illinois (in which county Chicago is located), special information has been compiled for the assistance of prospective bidders. A map has been prepared showing the location of sand, gravel and stone supplies in and adjacent to Cook County and giving the name of the owner in each case. This map shows also the railway connections. Another map shows not only the roads and railways, but also the location and car capacity of railway sidetracks in the county adjacent to the roads that are to be built. Thus, a contractor proposing to bid on any particular section can ascertain where and from whom supplies may be obtained, how they can be shipped to the work and where they can be delivered and stored. Blueprint copies of these maps are available in addition to complete plans and specifications for the work.

The roads will be 18 ft. wide (with a top surface or crown of 243-ft. radius) and will have 3- or 6-ft. shoulders, making a total width of 24 or 30 ft. between ditches. Bids are invited on (1) 7-in. concrete (6 in. at the sides and 8 in. at the middle), (2) 2-in. asphaltic concrete on 6-in. macadam base and (3) 2-in. asphaltic concrete on 5-in. concrete base. All the roads are outside the city limits of Chicago. Advertising for bids on individual sections will begin immediately and continue at two-week intervals. The work is under the direction of George A. Quinlan, County Superintendent of Highways, Court House, Chicago.

Syracuse Advised To Adopt a City Plan

The long expected report of B. J. Arnold, of Chicago, to the City of Syracuse, N. Y., on the elimination of railroad grade crossings, has very recently been made. A prominent feature is the recommendation that a definite plan for transportation-line and street revisions be made to accommodate expected city growth. The plan of City Engineer H. C. Allen, for placing the New York Central R.R. tracks from the east in the bed of the old Erie canal and from the west on the West Shore right of way, and changing the passenger station to West Genesee and West St. is approved. The Delaware, Lackawanna & Western R.R. tracks across the city would be placed upon a concrete viaduct. A union station is not recommended as needed at the present, especially as the Lackawanna here is more of a freight than a passenger carrier. The old New York Central station, at Franklin St., would be made an interurban trolley station and public market. The cost of the New York Central work is estimated to be $6,000,000—$300,000 for canal lands, $500,000 for damages, $5,200,000 for structures and added lands.

Department of Public Domain May Replace Minnesota Board

A department of public domain, consisting of a director under whom there would be five bureaus, each headed by a commissioner, is proposed by a bill now before the Minnesota Legislature. Nine commissions, boards and offices would be abolished and some of the duties of still others would be transferred to the new department as listed in the title of the bill:

State Drainage Commission, State Board of Timber Commissioners, Surveyors General of Logs, Minnesota State Forestry Board, Reclamation Board, Geological and Natural History Survey of the State of Minnesota, State Board of Immigration and the Offices of Commissioners and Superintendents of all State Parks, Forest Reserves and State Forests, and the State Highway Commission, and Conferring the Powers, Duties and Functions of Said Commissions, Boards, Offices and Institutions, and Likewise Such Powers and Duties of the State Auditor (Except as Limited by the Constitution), and of the Board of Regents of the University of Minnesota

as Relate to the Sale, Lease, Improvements, Superintendence and Administration of State Parks, Forests, Mines and the Products Thereof, Except Land on Which State Institutions Are or Shall Be Located.

In addition, some of the duties now performed by the Governor would be transferred to the director of the public domain.

The director would be appointed by the Governor with the approval of the Senate, and after a short term, ending in 1919, would thereafter hold office for six years. The commissioners heading the several bureaus would be appointed by the director for two-year terms. The director would be required to give a bond for $50,000.

The bureaus provided for by the bill are: (1) Land, Forest and Immigration; (2) Mines; (3) Game and Fish; (4) Drainage and Water; (5) Highways. The commissioners of the Bureaus of Highways and of Drainage would be civil engineers. Each of the commissioners would have to be "an expert in such matters" as pertain to his bureau, and "experts now in the service of the state, performing the same or similar duties shall be preferred for appointment." Appointments of all sorts would have to be made regardless of political or other affiliations "and according to a merit system devised and maintained by the director of public domain, designed to effect the greatest practicable economy and efficiency. Subject to the approval of the director of public domain and merit system in force, each bureau commissioner would have the right to appoint and discharge his subordinates and employees.

The commissioner of highways would have all the powers and duties relating to highways or state aid for highways now conferred by law on any state officer or board, including the state highway commission, and the state engineer or secretary of that commission, and his deputies. It would also be the duty of the commissioner of highways "to prepare a plan for a general system of state roads, which may be altered or extended from time to time" but "such plan will require the written approval of the director for the domain." The commissioner would also have power, subject to written approval of the director, to apportion state road and bridge funds among the political subdivisions of the state.

The location and plan for bridges over the Minnesota River now requiring the approval of the Governor would be transferred to the director of public domain.

The bill outlined in the foregoing paragraph was drawn by a commission appointed by the legislature two years ago. It has been indorsed by the present Governor and by the State Drainage Board, which consists of the Governor, the State Auditor and the Secretary of State. The only board or commission that is openly fighting the bill is the State Forestry Board. Some members of the legislature, however, are against the bill on the ground that it places too much power in the hands of one man.

An Engineering Council To Represent the Engineering Profession

Various movements have been started during the past year to effect some form of organization with authority to represent the whole engineering profession in public matters where its interests are concerned. A movement has now been started in New York to have the United Engineering Society, representing the four founder societies of Civil, Mechanical, Mining and Electrical Engineers, organize an Engineering Council, which, according to the plans, will "provide for convenient coöperation between engineering societies for the proper consideration of questions of general interest to engineers and to the public, and to provide the means for united action upon questions of common consent to engineers."

The Engineering Council is to be made up of delegates from such engineering and technical societies as may be invited to join it by the Board of Trustees of the United Engineering Society. Each society which may become a member of the Engineering Council will be entitled to one representative if it has not over 3000 members, and for larger membership it is entitled to an additional representative for each additional 2000 members or fraction thereof. The Council is to consider only matters which are brought to its attention by any of the societies represented upon it. "It may speak authoritatively for all member societies on all public questions of a common interest or concern to engineers, unless objection be made by one-fourth of the representatives."

The general plan of organization above outlined was approved at a meeting held on Feb. 8, at which the principal officers of the four founder societies were present. The proposed plan of organization is to be further considered by the Board of Trustees of the United Engineering Society at its meeting on Friday, Feb. 23, and will come up for final action at a special meeting on Mar. 8.

An Engineering Commission of five unpaid members has been authorized at Atlanta, Ga., to advise the city government on technical matters. Services of members of the affiliated engineering societies have been offered.

A State Health Commissioner for Ohio in place of a State Board of Health is proposed in a bill before the legislature. The Governor would name five members of a Health Council which would make one of its members Commissioner. The Council would have no executive or administrative powers.

A Review of the Flood-Control Plans of Los Angeles County, California, developed by J. W. Reagan, Chief Engineer of Flood Control for the County Board of Supervisors, is likely to be made by a special board of engineers made up of William Mulholland, Chief Engineer of the Los Angeles Water Department, who was named by the Los Angeles Chamber of Commerce; John Quinton, named by the Municipal League, and Homer Hamlin, City Engineer, named by the Finance Committee of the City Council.

A Large Electric Steel Plant with a capacity of 300 tons per day is to be built at Toronto, Canada. The works are being erected by the Imperial Munitions Board on a tract 60 acres in extent in the Ashbridge Bay district on the lake front. The works will contain ten Heroult type electrical furnaces, each taking about 2000 hp. of 3-phase 25-cycle current, which will be supplied by the Provincial Hydro-Electric Commission. Scrap metal will be used as the raw material, and 800 to 1000 men will be employed. Work on the foundations started on Jan. 19, and the plant is to be rushed to completion to supply high-grade steel for shell making.

The Montreal Aqueduct Power Project will be investigated by an independent board of engineers engaged by the City Council. A voluntary commission of rate-paying engineers, local members of the Canadian Society of Civil Engineers (W. S. Tye, Sir John Kennedy, Ernest Marcean, J. A. Jamieson, R. A. Ross, Arthur Surveyer and W. J. Francis), as noted in "Engineering News," Nov. 30, 1916, has reported that the scheme is so unreliable and expensive that the city had better lose the money spent than try to finish the work. About $5,000,000 has been spent out of a possible $11,000,000. The power plant is intended to develop 10,000 hp. The City Engineer has formally disputed the finding of the voluntary board. The new commission is composed of A. St. Laurent, J. B. McRae and H. E. Vautelet.

Sewage Improvements for Detroit, Mich., totaling $8,491,900 are included in the 1917-18 estimates submitted to the City Council by Clarence W. Hubbell, city engineer. This sum would provide for over 30 mi. of sewers and also for a disposal site on Connors Creek estimated to cost $120,000. The complete sewerage program drawn up by Mr. Hubbell to meet the needs of the next few years calls for an outlay of $16,000,000.

PERSONALS

Murray M. Duncan, M. Am. Inst. M. E., manager of the Cleveland-Cliffs Iron Co., Ishpeming, Mich., has been made Vice-President of the company. He is located at Marquette, Mich.

William N. Jones, Assoc. M. Am. Soc. C. E., Engineer of Design and Construction, St. Paul Water Department, has been appointed Engineer in charge of construction at the Minneapolis (Minn.) filtration plant, at a salary not to exceed $5000 per annum.

W. K. Walker, Assoc. M. Am. Soc. C. E., formerly Senior Civil Engineer, Interstate Commerce Commission, Kansas City, Mo., has been appointed Engineer Maintenance-of-Way of the Detroit Division of the Wabash Railway Co., with headquarters at Montpelier, Ohio, in place of R. S. Charles, transferred.

Robert C. Wheeler, Assoc. M. Am. Soc. C. E., has resigned as City Engineer of Summit, N. J., to become Acting General Manager of the Vincennes (Ind.) Water-Supply Co., the Greencastle (Ind.) Water Co. and the New Chester (Penn.) Water Co. He succeeds the late A. W. MacCallum and will have headquarters at 26 South Third St., Philadelphia.

J. T. Collins, Assoc. M. Soc. C. E., formerly Chief Engineer, Department of Public Works, Santo Domingo, has been appointed General Manager of Dominican Government Railroads by the Head of the Military Government, H. S. Knapp, Captain, United States Navy. He will have charge of construction, maintenance and operation of all railroads owned and operated by the Dominican Government.

Henry Welles Durham, M. Am. Soc. C. E., County Engineer of Bergen County, New Jersey, during 1916, and who failed of reappointment during service on the Mexican border, was tendered a dinner on Feb. 3 by certain citizens of the county, interested in a nonpartisan administration and good government. Addresses were made by Mayor Blake, of Englewood, and other public officials.

Harry D. Appleby, former Chief of the Topographic Bureau of the Department of Public Works, Borough of Manhattan, New York City, has been appointed Designing Engineer, Bureau of Yards and Docks, Navy Department, Washington, D. C. He is a graduate of the University of Michigan and for some time was with the Public Service Commission on subway work in New York as an Assistant Designing Engineer.

Gen. George W. Goethals has opened offices for the practice of consulting engineering at 43 Exchange Place, New York City. General Goethals has associated with himself a staff of experienced specialists and will carry on a general consulting practice in civil, electrical, mechanical and hydraulic engineering. It is understood that some of the engineers who have been associated with General Goethals in the Panama Canal work will join him in his practice.

Hugh B. Holmes, formerly Resident Engineer at Kansas City, Mo., of the Kansas City, Mexico & Orient R.R., has been appointed Chief Engineer of the railroad, with headquarters in Kansas City. Mr. Holmes entered railway service in 1899, with the Chicago, Burlington & Quincy R.R., as a rodman. He began service with the Orient R.R. in 1900 as topographer on preliminary surveys in the State of Chihuahua, Mexico; afterward serving as levelman and transitman on location. In 1904 he was Resident Engineer on the construction of the first 20 km. of the La Junta-Temosochic extension of the Chihuahua & Pacific Ry. (now the Mexican Northwestern Ry.). He reëntered the service of the Orient in 1905 as Chief Clerk and Assistant to the Superintendent of Construction at Chihuahua, in which capacity he served until 1909. In 1912 he was appointed Resident Engineer in charge of the engineering department of the receivers of the railroad.

Dr. W. F. M. Goss, M. Am. Soc. M. E., Dean of the College of Engineering, University of Illinois, has resigned, effective Mar. 1, to become President of the Railway Car Builders' Association, which is made up of representatives of 15 different companies engaged in the manufacture of railway cars. The object of the association is to establish coöperative relations between manufacturers and purchasers and especially in the matter of standardizing design and specifications. Dean Goss organized the Department of Practical Mechanics at Purdue University in 1879. He was Instructor, Professor and Director of the Engineering Laboratories there until 1907, when he went to the University of Illinois. He was in charge of the locomotive-testing plant of the St. Louis Exposition in 1904 and has served as Chief Engineer of the Commission on Investigation on Smoke Abatement and Electrification of Terminals at Chicago, Ill. He is a past-president of the American Society of Mechanical Engineers.

OBITUARY

Thomas M. Bannon, engineer, Topographic Branch, United States Geological Survey, died on Feb. 4 in Baltimore. He had been connected with the Survey since 1888.

Frank H. Martin, an architect and member of the firm of Martin & Hall, Providence, R. I., died at his home, on Feb. 2, from pneumonia. He was 53 years old.

Roger Kennedy, a Connecticut contractor, died at South Farms, Ind., from apoplexy, on Feb. 6. He is said to have built many of the docks along the Connecticut River. He was born in Ireland in 1847.

Charles T. Schoen, reported as the originator of the pressed-steel car now in general service on railways, died in Moylan, near Philadelphia, on Feb. 4, at the age of 72. When 20 years old he became manager of a spring factory at $12 per week. It is said that the next year he was raised to $30 and given a fifth interest in the profits, amounting to $17,000. In 1889 he designed his pressed-steel car.

Samuel Forsythe Thomson died after a short illness at his home in Brooklyn Borough, New York City, Jan. 30, 1917, at the age of 44. He was born at Charleston, S. C., June 5, 1872. After graduating from the Massachusetts Institute of Technology in 1896 he took service under Col. George E. Waring, Street Cleaning Commissioner, New York City. He then went to West Point as an instructor in civil engineering. After several years in that capacity he returned to New York and entered the service of the Rapid Transit Railroad Commission, being assigned as assistant engineer on the construction of the East River tunnels of the Interborough System under Division Engineer Robert Ridgway. In the spring of 1906, soon after the Board of Water Supply of New York City was organized, Mr. Thomson, again serving under Mr. Ridgway, went on to the Walkill Division of the Catskill Aqueduct, where he remained throughout the entire construction of that portion of the aqueduct, first as assistant engineer and then as acting division engineer in charge of the work. The value of the construction work on this division was approximately $6,000,000. The last three years of his life he spent in New York City with the Kingsbridge Contracting Co. as engineer on several large sewer contracts.

George Henry Hill, M. Am. Inst. Elec. E., a member of the engineering staff of the General Electric Co. at Schenectady, N. Y., died on Jan. 31 after a brief illness from pneumonia. Mr. Hill was born at Williamsport, Penn., in 1872. He received his education at Dickinson Seminary and Johns Hopkins University. He graduated from the latter institution in 1895 and took up work with Frank J. Sprague on the development of electric elevators and multiple-unit control for railway trains. He soon became chief of construction of the elevator department, and when this class of work was relinquished by the Sprague company in 1900 he became chief engineer of the company's works at Bloomfield, N. J. In 1902, when the Sprague patents were taken over by the General Electric Co., Mr. Hill joined the forces of the latter company and had responsible charge of the further development of multiple-unit train control. As assistant to S. E. Case, he had charge of the manufacture of the car equipment for the elevated and subway lines in New York, Boston, Chicago and Philadelphia, as well as much work for foreign countries. Since 1906 Mr. Hill has been Assistant Engineer of the railway and traction department, and was in charge of the group of engineers dealing with the general problems arising in connection with electric-railway development. In this position he was one of the company's most important advisers. Mr. Hill made many important inventions in connection with his work, taking out over 40 patents. Among these was a broad patent on the system of electrically operating bulkhead doors in ships. Mr. Hill had been a frequent contributor to technical journals and to the "Proceedings" of the American Institute of Electrical Engineers, which he joined in 1899. He was chairman of the Schenectady section of the Institute during 1915. Mr. Hill was married in 1899 to Miss Hazel Thompson, of Bloomfield, N. J., who with three sons survives him.

ENGINEERING SOCIETIES

AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 19-22. Meeting in New York City. Secy., Bradley, Stoughton, 29 W. 39th St., New York City.

SOUTHWESTERN CONCRETE ASSOCIATION.
Feb. 19-24. Southwestern Concrete Show in Kansas City, Mo. Address Chas. A. Stevenson, 1413 W. 10th St., Kansas City.

CONNECTICUT SOCIETY OF CIVIL ENGINEERS.
Feb 20-21. Annual meeting in New Haven in Mason Laboratory. Secy., J. F. Jackson, New Haven.

IOWA STATE DRAINAGE ASSOCIATION.
Feb. 20-21. Meeting in Fort Dodge. Secy., M. F. P. Costelloe, Ames.

IOWA ENGINEERING SOCIETY.
Feb. 21-23. Annual meeting in Ames. Secy., J. H. Dunlap, Iowa City.

AMERICAN CERAMIC SOCIETY.
Mar. 5-8. Annual meeting in New York City. Secy., Edward Orton, Jr., Columbus, Ohio.

NATIONAL BRICK MANUFACTURERS' ASSOCIATION.
Mar. 5-10. Annual meeting in New York City at McAlpin Hotel. Secy., T. A. Randall, Indianapolis.

CENTRAL ELECTRIC RAILWAY ASSOCIATION.
Mar. 8-9. Annual meeting in Indianapolis. Secy., A. L. Neereamer, Indianapolis.

NEW ENGLAND RAILROAD CLUB.
Mar. 13-17. Annual meeting in Boston. Secy., W. E. Cade, 683 Atlantic Ave., Boston.

WISCONSIN ELECTRICAL ASSOCIATION.
Mar. 15-16. Convention in Milwaukee. Secy., George Allison, First National Bank Building, Milwaukee.

NATIONAL RAILWAY APPLIANCES ASSOCIATION.
Mar. 20. Annual meeting in Chicago at Coliseum. Secy., C. W. Kelly, Kelly-Derby Co., Chicago.

ILLINOIS GAS ASSOCIATION.
Mar. 21-22. Annual meeting in Chicago. Secy., Horace H. Clark, 1325 Edison Building, Chicago.

The Oregon Society of Engineers held its annual meeting on Feb. 5 at the University Club, Portland, the occasion being a "dollar dinner."

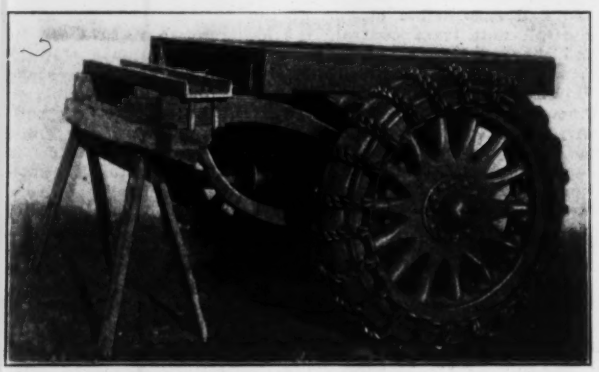
The American Chemical Society will hold a spring meeting in Kansas City, Apr. 10 to 14. In addition to the business and technical sessions, there will be a smoker, a banquet and excursions. The secretary is Charles L. Parsons, Box 505, Washington, D. C.

The North Dakota Society of Engineers, at its annual meeting Jan. 30 and 31, elected the following officers: President, J. A. Ingram; vice-presidents, R. H. Slocum and J. H. Clarke; secretary, E. S. Chandler, University, N. D. The proposed law for the licensing of land surveyors, previously prepared by the society, was modified slightly and again submitted to the Legislature. It provides for the examination (and licensing upon proof of qualifications) of land surveyors in the state, and provides that none except licensed surveyors shall be allowed to hold the office of county surveyor, or to issue surveyor's certificates or certified plans or plats for filing, in any case where the location of property lines is thereby involved. The next annual meeting will be held at Fargo.

Appliances and Materials

Tractors Made from Pleasure Cars

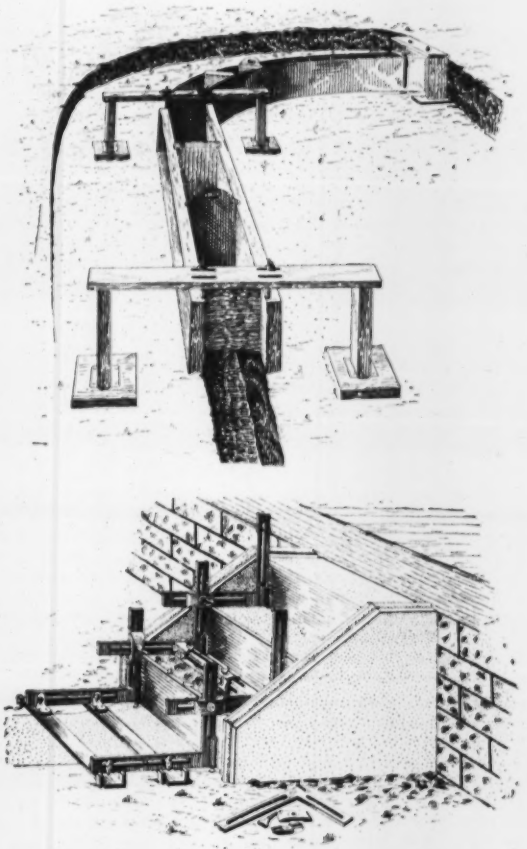
The Knox Motors Co., of Springfield, Mass., has designed a traction unit that converts a pleasure automobile into a three-ton tractor. It is aimed by this to provide a use for the thousands of second-hand cars coming upon the market each year and for which there now seems to be no outlet. This device replaces the rear axle and wheels and the rear part of the body. The unit has the spring suspension of the regular Knox tractor for the end of the car frame, and the heavy weight of useful load is transferred directly to the new rear axle through a separate set of springs. The cross-channel of the unit is bolted to the frame of the car, and the propeller shaft is connected to a universal-joint flange on the drive-axle internal gear. After hooking up the brake rods the tractor is ready. Where a dray is used as a load carrier, a special bolster is fastened on the front end (the wheels and tongue being removed) and connected with the tractor turntable. This unit sells for $550.



KNOX CONVERTING TRACTOR UNIT

New Curb and Step Forms

The steel form for concrete curbing shown herewith is suspended from above instead of being supported from below in the more usual way. At intervals are placed posts or stools carrying crosspieces having slotted holes to receive bolts on the top of the form plates. Wing nuts on these, and resting on the crosspiece, provide for adjusting the elevation of the forms. Transverse clamps, shown on either side of the middle support, keep the side plates in proper position. Between the first support and the first crossclamp is a templet with handhole. This is left in place while the concrete is being deposited and is then removed, leaving a joint in the curb.



SUSPENDED FORM FOR CONCRETE CURBING AND NEW FORM FOR STEPS

The form for concrete steps is composed of a series of L-shaped arms, with each side slotted to receive clamping bolts. The bottom arms are set on anchor plates carefully leveled, so that no further plumbing or squaring is required in setting the additional arms for the side frames. Between the side arms is moved a strike or templet, which is made telescopic so as to be adjustable for various widths of steps. It is made of a pair of angles, with slotted holes for clamp bolts. This templet moves on guides under the side arms, these being adjusted to give the desired slope for the surface of the step. The slotted L-frames are used also for curb forms.

These curb and step forms are among the specialties of the H. D. Cornelius Co., 3012 Calvelage St., Cincinnati, Ohio.